N5 Building Administration

Gateways to Engineering Studies - Chris Brink

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	Checklist		Practical
	Demonstration/ observation		Presentation/ Lecture
	Did you know?		Read
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	Experiment		Site visit
	Group work/ discussions, role-play, etc.		Take note of
	In the workplace		Theoretical – questions, reports, case studies, etc.
	Keywords		Think about it

Module 1

Mechanical Plant Required for Building Work

Learning Outcomes
On the completion of this module the student must be able to:

- Describe the types of plant used for:
  - Levelling
  - Excavating
  - Loading
  - Mixing
  - Compacting
- Give a brief description of the plant and it's utilisation
- Describe the selection of mechanical plant for various purposes
- Describe the following:
  - Sequence utilisation
  - Maintenance
  - Servicing

1.1 Introduction

Mechanical plant has today become extremely important on most contracts, high wages together with the unreliability of labour productions have made it uneconomical for men to do work when mechanical equipment can reasonably be used, and consequently plant plays an increasingly important role in building, as well as civil engineering operations, where both time and money can be saved by the efficient use of mechanical aid.

Modern transport has also facilitated the movement of plant from one site to another to such extent that it is easier and more convenient to transport plant as compared to labour.

Plant is not subject to wage fluctuation and go slow strikes, and the uniform output of a machine, apart from breakdowns, considerably simplifies estimating and planning of jobs.

The full advantages can only be obtained if the plant is well managed both on and off the site and this requires a thorough understanding of the economic aspects of using plant and vehicles.

Did you know?
The usual form of power employed for building plant includes: electricity, petrol, diesel, compressed.

An immense task lies before the building industry and, because if other national demands on manpower, the available labour force cannot be expanded, so that new methods must be evolved by which greater and more effective use can be made of mechanical plant.

1.2 Different types of mechanisation

1.2.1 Electricity powered plant

This is a common source of power in permanent workshops, joinery mills, etc. It is clean and reasonably cheap as a source of power and is also very reliable.

Note:
The capital outlay and maintenance costs are lower than diesel oil, less attention is required in checking gauges and oil levels than would be the case if petrol or diesel were used.

On building site, however, it is not always easy to obtain a suitable electricity supply and for this reason alone many contractors do not use electricity. If it is used on a site great care must be taken with cables and a meter and main control panel must be situated in a suitable watertight position.

1.2.2 Petrol powered plant

These machines are cheaper in initial outlay than diesel but the fuel is more expensive. Smaller plant on building sites is normally operated by a small petrol engine.

1.2.3 Diesel powered plant

The capital cost is high which is more than made up by longer life, cheaper fuel. Many diesel engines are now air cooled which is an added advantage particularly in winter months. The storage of diesel fuel is no difficulty on building sites.

1.2.4 Compressed air

Compressed air is useful and flexible for small tools, the air compressor is driven by electrical motors, pressure being constant by delivering compressed air into a suitable receiver from where it is delivered to the tools by pipelines of rubber tubing.

1.3 Selection of mechanical plant for various purposes

When choosing plant, capital outlay, running costs, and maintenance costs must all be carefully considered as a larger proportion of the fixed capital of the contracting industry is absorbed by plant, it becomes more important that it should be used to its full working capacity in order to pay for itself and help reduce construction costs.

With the large selection of mechanical plant now available, the most economical choice of machines and methods of operation in any situation is not always obvious and must be determined by comparative costing.

While it is obviously desirable that the plant department should be profitable this should never be achieved at the expense of contracts, for its primary function must be to provide a service to other departments of the company.

This requires that general management should not only have a clear objective but also reliable information upon which to base rational desires. Highly competitive tendering relies upon factual costing of plant for estimating purposes and in civil engineering particularly the choice of methods can be decisive.

Note:
All these factors underline the necessity for obtaining the true operative cost of all plant.

1.4 Planning

1.4.1 Selecting equipment

When planning how a contract is to be carried out the first question that has to be answered is, what mechanical plant can best carry out the various operations. When, some excavation work has to be done for example, it must be determined if there is a sufficient work to warrant the use of such plant.

The site may be restricted inaccessible of hilly, and these factors would definitely reduce output, consequently hand labour may be required instead of machines. All these factors indicate the absolute necessity for visiting the site and it goes without saying that in unfamiliar areas sub soil investigation is essential.

After the site conditions together with the relative positions of adjoining buildings have been ascertained the most suitable types of equipment would be selected bearing the following points in mind:

- what type of machine to be chosen;
- for economic reasons will there be sufficient work to keep the machine occupied;
- will there be sufficient labour and allied services to maintain a steady output.

Having decided what mechanical plant is necessary consideration must be given as to the best type of equipment to select. For excavating it may be a dragline or a face shovel. Under certain conditions a tractor shovel or a bulldozer say a D4 which is capable of pushing 35 cubic metres per hour with an average push of 15 metres.

Also the site conditions must be considered and it should be determined whether the mechanical equipment should be of caterpillar type or on wheels.

Note:
Weather conditions will play an important part as the site may become so muddy as to cause mobile plant to be bogged down.

What about concreting equipment? Would one 700/500 concrete mixer with an output of about 4,5 cubic metres of concrete per hour be suitable or could two smaller mixers be more suitably employed. On a large job hatching plant may be suitable considering the placing of concrete.

The advantages of skip, barrow hoist, concrete pump, crane or other methods would have to be compared. The question of keeping excavations free from water would involve a comparison between normal pumping or use of well point dewatering equipment.

1.4.2 Keeping to programme

The use of mechanical equipment or a contract created certain problems and for this reason programming needs careful consideration, and for this reason also, when preplanning a job the complete programme is often built up around available mechanical equipment.

In large contracts a programme must be drawn up. At several peak periods a large amount of equipment is employed and where possible it should be so arranged as to flatten out these peak periods and thus avoid undue congestion and rush. A great advantage of this programme is that it clearly indicates when such plant will be available for other contracts.

Needless to say regular periods should be allowed in the programme for breakdowns and preventative maintenance to ensure that the plant will arrive on the site in first class condition and can be completely relied on.

Note:
Servicing should be carried out in all cases while plant is not in use.

1.5 The problem of congested sites

The more valuable land is invariably in the busier and more congested streets and the incentive is always to fill as much of the space as possible with useable

or rentable area. It is usual when carrying out construction work on this type of site that the contractor meets most of his access problems which can be extremely complicated.

This aspect should be well thought out as heavy losses can occur to the contractor who has given insufficient thought to the access problem. Local by-laws are very strict in making provision for the hoarding of gantries and the amount of enclosed street space that they will permit. Special permission has to be obtained from the City Engineer. (Refer to local by-laws.)

Most congested site require the use of gantries for storage of materials and protection of the public during loading. This requires the introduction of a light crane.

Power cranes are extremely useful on building sites, there are many types: power cranes, travellers, mono-towers, climbers, self erectors, fixed or travel jibs, luffing jibs, fixed towers, etc, all have their various uses but it is important to choose the right type for the job.

A travelling crane is usually rail mounted and can reach more parts of the site than a fixed crane, but room must be found for the crane clear of the scaffolding, and this may be impossible on a congested site.

Mono-towers or climbers are generally more suitable for this type of site but these generally are of smaller lifting capacity and the building has to be able to support the entire weight of the crane, mono-towers require a good foundation to support the dead weight and tail down the tower from overturning. Although this overturning may be prevented with a counterweight by using ballast.

Note:
Fixed towers take up less room than slewing towers, some of which have guy ropes.

The fixed tower may require a space of less than 1,8 metres by 1,8 metres and may pass through a duct left out of the floor and roof slab, but a slewing tower may require a turning circle of more than 6 metres diameter.

Slender fixed towers are usually stable to a height of 18 metres but above this the tower must be fastened to the building by means of a bracket - here the consulting engineer's opinion must be obtained with regard to the ability of the structure to withstand the additional forces.

A type of entirely self-erecting crane relies upon the tower being laid out horizontally and hauled upright by the guy ropes.

Once again consideration must be given to the availability of space to accommodate such erection.

Fixed or saddle jib cranes are usually faster in operation than those with luffing jibs but if the building site is bounded by tall buildings or other high obstructions it may be necessary to employ the latter type.

1.6 Classification of plant

The machines and power tools which are the subject of this course are divided into three classes according to their degree of mobility:

- fixed
- portable
- mobile

The first group includes machines which operate from a fixed position relative to the site: the second group, machines and tools which can be moved about by pulling, pushing or carrying by hand, and the third group, those which can move from one place to another under their own power.

In addition to this classification, according to mobility, most mechanical plant can be further divided into classes according to their function, and are described under the following headings: Excavating, Hoisting, Transporting and Mixing.

1.6.1 Excavators

In the context of mechanical plant, and excavator consists of a power unit to which various attachments are fitted so that different types of excavation can be carried out. Each attachment consists of a jib to which is fixed a container (the bucket). The jib is hinged to the body of the machine which can rotate about the base.

Most excavators are on tracks; these excavate while remaining in one position, and normally transport material only within the reach of the jib. Some excavators are on wheels, enabling them to transport material over short hauls.

Bucket capacities are usually in the range 0,5 m - 5 m^2, the face-shovel and dragline generally have capacities at the higher end of this range and, for special purposes, may be much larger.

Note:
All back-actors, and many face-shovels and clamshells, are hydraulically-operated. The dragline action makes the machine unsuitable for hydraulic power.

a. Back-actor

This machine, also known as a backhoe, is used primarily for the excavation of trenches, although it can be used for other types of excavation below the level of its base. Excavation is carried out by a backward and upward scooping motion of the bucket.

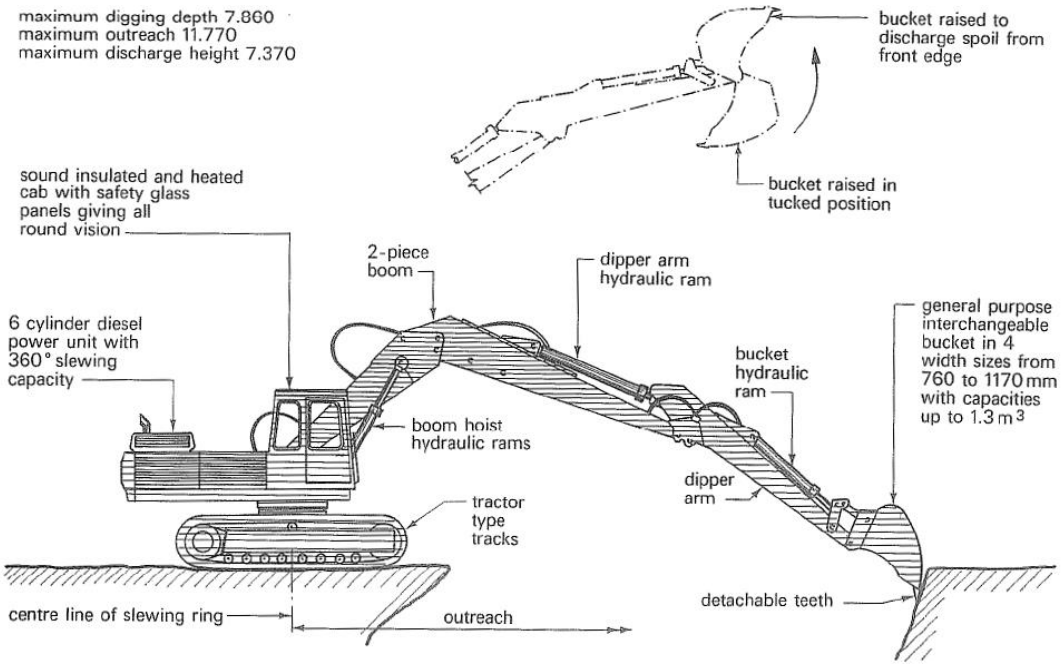

Figure 1.1 Typical back-actor details

b. Face-shovel

This machine is used to excavate in vertical, or nearly vertical, faces above the level of its base. It is particularly suitable for working quarry faces.

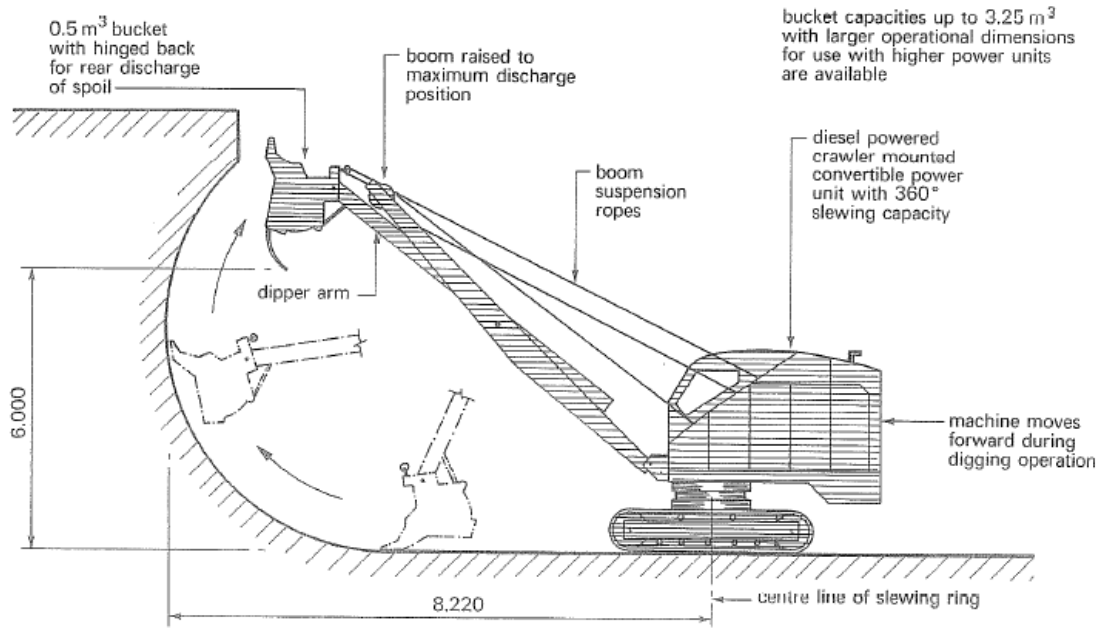

Figure 1.2 Typical face shovel details

Excavation is carried out by a forward and upward motion of the bucket which forces the material into it.

c. Dragline

The machine is used for general excavation both above and below the level of its base. It has a one-piece job, and a bucket which is supported by wire ropes. The bucket is rectangular in plan, and is open at one end where a toothed cutting edge is fitted to it.

By suitable activation of the ropes and the job, the bucket is thrown outwards into the material which is to be excavated.

It is then dragged back towards the machine, causing material to be forced into the bucket.

Different activation of the ropes rotates the bucket so that the material is released.

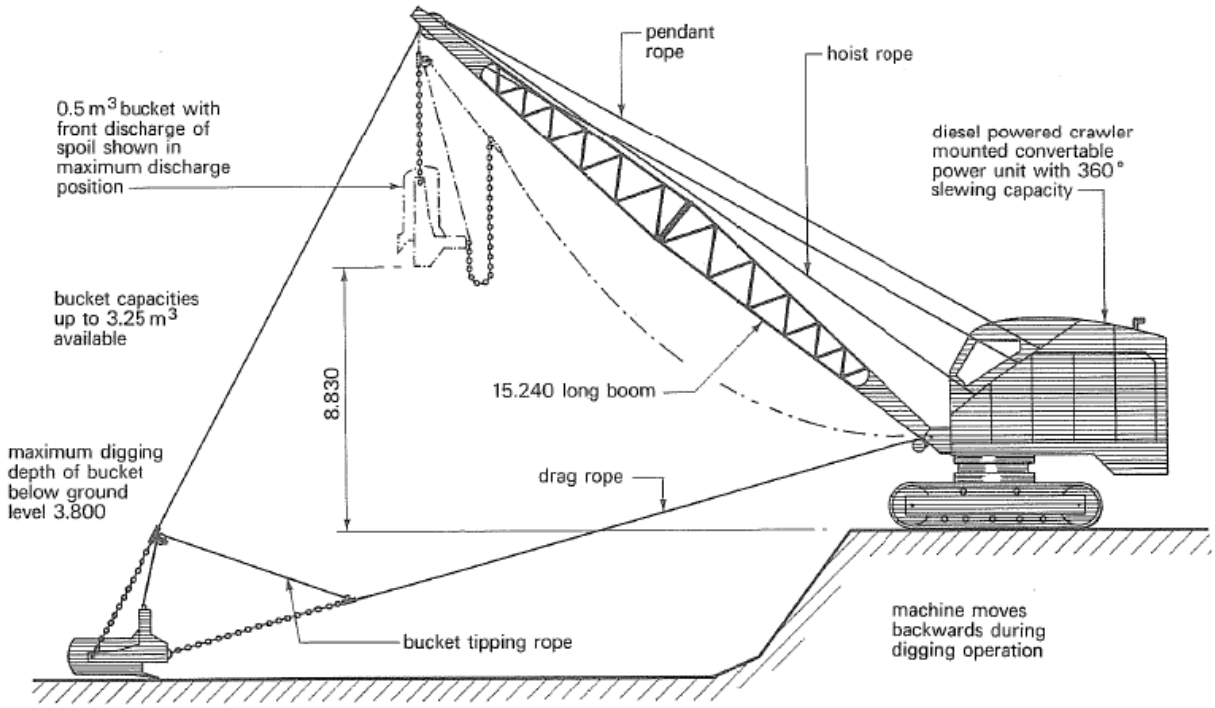

Figure 1.3 Typical dragline details

d. Trenching machine

Consists basically of a number of buckets mounted on a wheel or continuous chained mounted on a vertical boom similar to a dredger.

A transverse belt conveyor immediately under the line of filled buckets deposits the soil on either side of the trench being excavated.

	**Note:** Because its speed in cutting is fast, it is more economical than a back-actor when there is a large amount of trenching work to be executed; it is designed as a single special purpose machine.

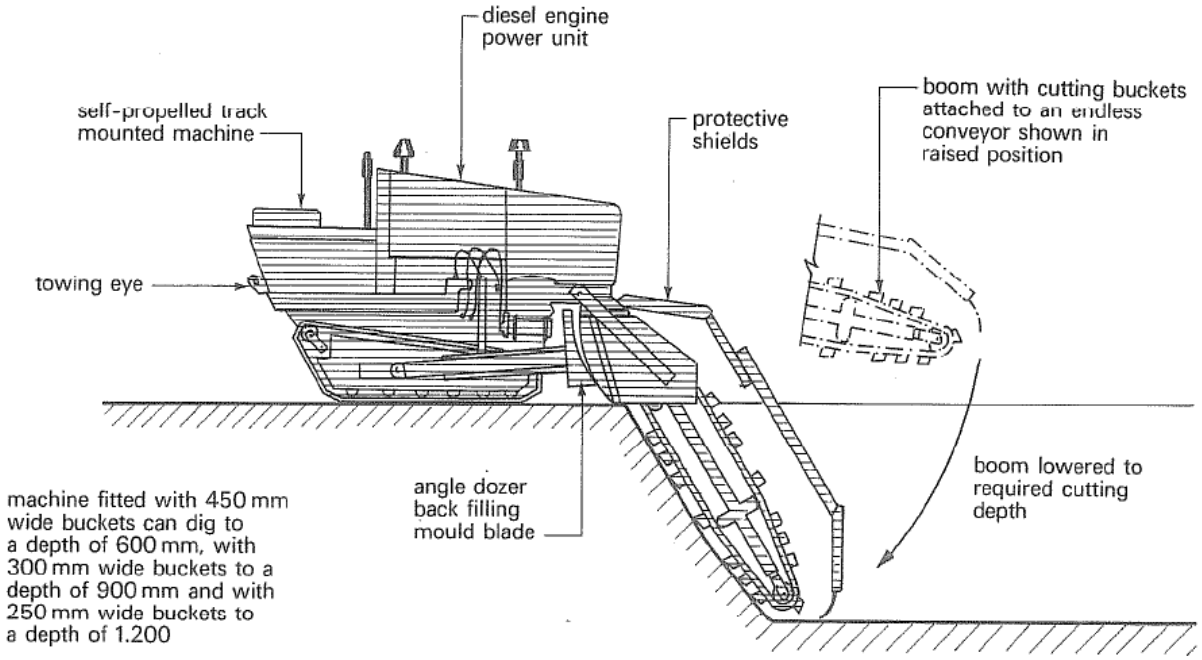

Figure 1.4 Typical trench digging details

1.7 Cranes

Cranes give three dimensional movement and are therefore particularly useful in solving handling problems.
They may be divided into two broad groups:

- Mobile cranes
- Stationary cranes

1.1 Mobile cranes

Mobile cranes may either be self propelled or lorry mounted. The self propelled cranes include those mounted on pneumatic tyres which can be driven at slow speeds from site to site on normal roads, but they need hard ground on which to work o the site.

Note:
On most sites a crawler mounted crane is necessary if the crane is to be used on unprepared ground.

Lorry mounted cranes have a greater mobility on the road even a pneumatic tyred self propelled crane, but are somewhat less mobile on the site, their primary use being for highly mobile purposes requiring rapid movement from one site to another.

When used for distributing operations in building work it is necessary for the crane to stand some distance away from the building, in order that the low-mounted jib shall not foul the top of the building.

1.2 Stationary cranes

These are fixed firmly at their working position.

a. Guyed Derrick

A derrick is a simple and inexpensive crane used where a few comparatively heavy lifts have to be made. The guyed derrick may be erected on the ground or on the building under construction and it is very widely used for erecting steel frames.

b. Scotch Derrick

This consists of a slewing mast and a derricking jib. The mast is maintained in a vertical position by two latticed steel stay members which run from the top to the extremities of two base sleepers which are either loaded at the ends with ballast or kentledge or are anchored to heavy concrete blocks.

Like the guyed derrick, Scotch derricks are used widely for the erection of steel frames.

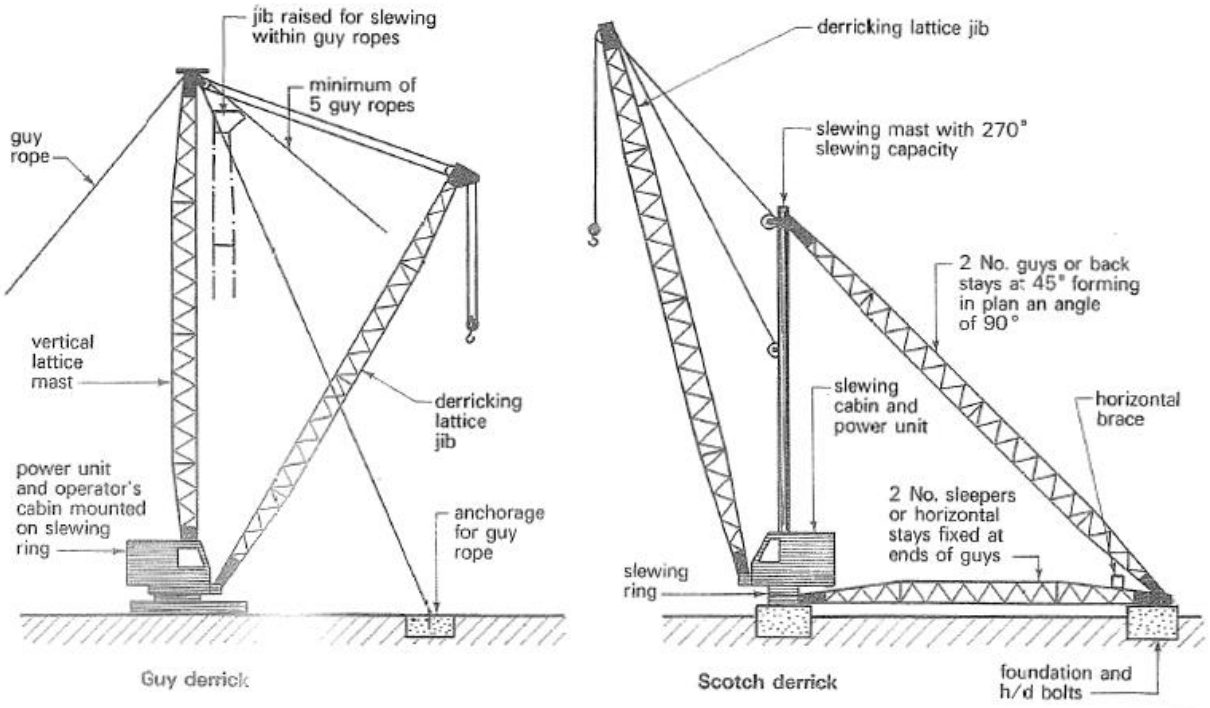

Figure 1.5 Derrick cranes

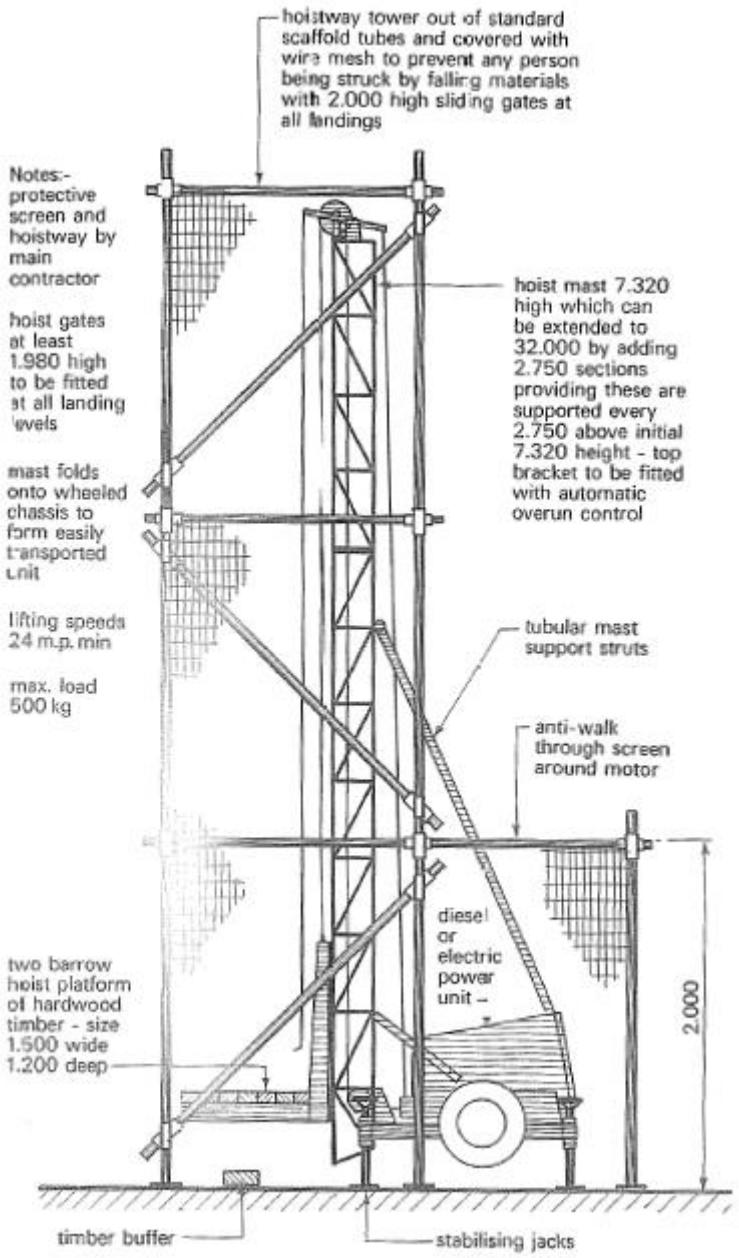

Figure 1.6 A typical materials hoist

c. Travelling Crane

Where conditions permit, a rail mounted or travelling crane moving along the side of the building has the advantage of increased coverage due to the movement along the rails. A firm level track is essential and this sometimes presents difficulties on sloping areas.

1.8 Hoists

A hoist consists of a horizontal platform which is moved up and down vertical guides by a powered winch and is usually termed a platform hoist, although the platform is sometimes replaced by a tipping skip to carry concrete. The guides are tied back to the structure or to scaffolding in order to provide stability.

1.8.1 Platform hoists
They are commonly made in sizes up to about 1 500 kg capacity although larger models up to a capacity of 3 000 kg are made.

The platform is side hung for the lower capacities and centre hung in a similar manner to a lift for the higher capacities.

1.8.2 Mobile platform hoists
These hoists have been developed primarily for house building. In these the guides are fixed to a vertical mast which is mounted on a chassis and two tyred wheels on which the hoist is moved.

1.9 Elevators
These consist of a rotating belt or chain to which are fixed buckets or lugs depending on the nature of the materials to be raised.

1.10 Transporting
The term transporting implies horizontal movement primarily but it can involve some vertical movement, as in the case of conveyors and concrete pumps, and the plant used for this purpose varies widely in its nature.

1.10.1 Dumpers
These are designed for the transport of materials such as excavated spoil, hardcore and concrete. They are powered by a diesel engine or, on the smaller types, by petrol engine.

The smaller types generally called power barrows, are three-wheeled driven and steered on the back wheel by a pedestrian driver. The larger types (up to 6 cubic metres) have four tyred wheels with front-wheel drive and rear-wheel steering, with a driving seat or saddle placed so that the hopper or skip is in front to give a view for placing the load.

1.10.2 Conveyors
The usual type of conveyor used on building sites is the portable belt conveyor. They can be used to handle any small quantities of materials, such as excavated spoil, from the point of excavation to the point of loading for transport and for concrete placing.

The conveyors are usually electrically driven with a master switch at the discharge end controlling the whole conveyor belt.

1.10.3 Concrete pump and placers
Pumps are mechanically operated by ram and placers are pneumatically operated by compressed air.

In the mechanically operated pump the concrete is pumped along a pipeline from the hopper by means of a ram pump and the pipe is ahvays fulJ of concrete, which comes out as a continuous discharge at the end. With a pneumatically operated placer, the concrete is blown from the hopper in batches along the pipeline and the pipe is clear most of the time.

1.11 Mixing

In modern building construction a large amount of material mainly concrete, mortar and plaster must still be mixed with water. Of these concrete is probably made the most and the mixing of it has been most highly mechanized. Except on mobs requiring only an extremely small amount of concrete, a concrete mixer of some form is now used on every bui lding site.

The advantages of mechanical mixing over hand mixing, except for very small quantities are;

- greater economy
- certainty of thorough mixing without loss of cement
- accurate gauging of the water content

1.11.1 Concrete mixers

Concrete mixers are made in various types and sizes, the most commonly used being drum mixers of which there are two forms:

- non-rotating
- tilting

Note:
Mixers larger than 0,50 cubic metres are usually designated by their actual output in cubic metres per batch.

Concrete mixers may be classified as follows:

a. Non-tilting drum mixer

In this type the drum is cylindrical with partially closed ends and rotates in a vertical plane, the mixed concrete being discharged either by means of a chute or by reversing the direction of rotation of the drum. Charging of the drum is carried out by a power loading side hopper or skip.

Some models are automatic in action, producing one batch after another only needing to be supplied with materials and an with skips or other transport to take each batch as it is discharged.

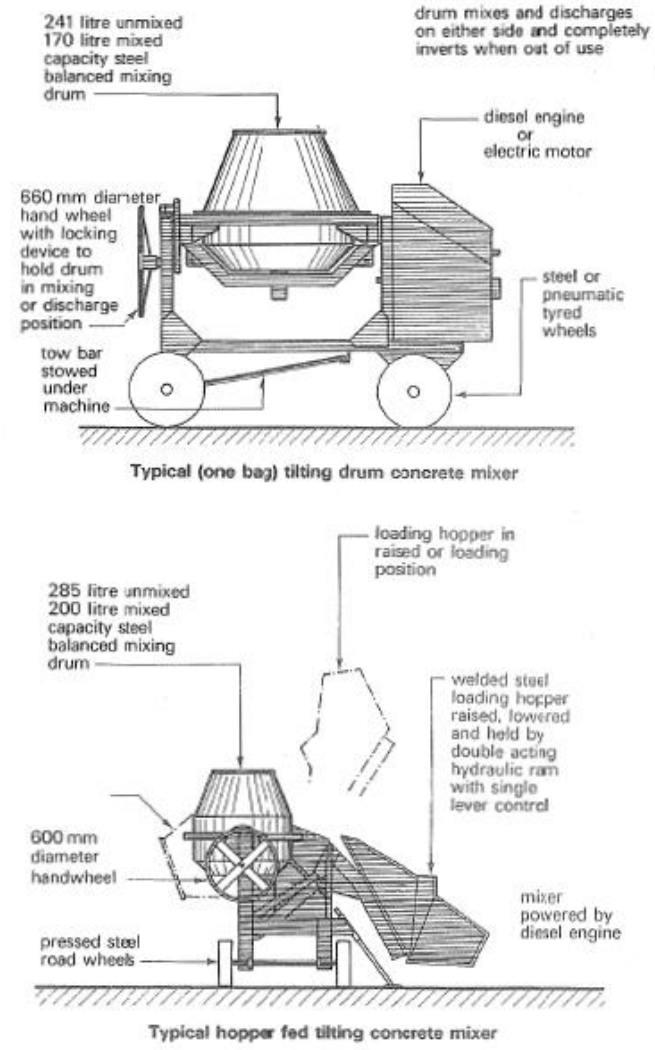

Figure 1.7a Concrete mixers

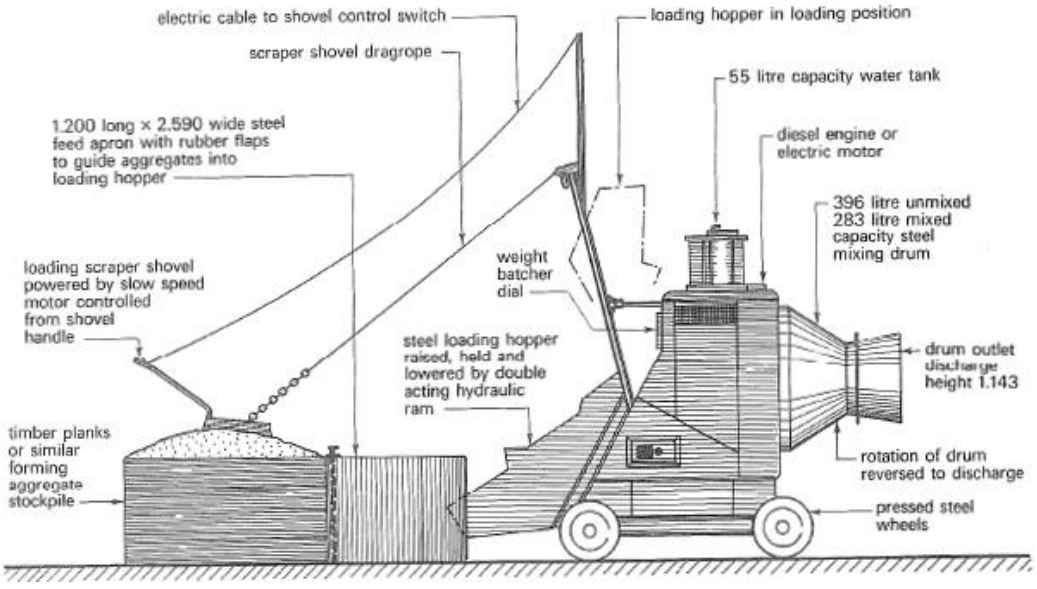

Figure 1.7b Typical reversible drum mixer

b. Tilting drum mixer
This consists of a pear-shaped drum open at the narrow top end and revolving on a tilting axis which permits the drum to be tilted in one direction for loading into the open end, and in the opposite direction for discharging the batch of mixed concrete.

1.12 Power tools
They are used for many purposes and the range of variety in each type of tool is so great that it is only possible here to list the principal types.

The majority of power tools have the engine or motor incorporated as an integral part of the tool.

1.12.1 Picks, breakers and rock drills
These are used for breaking up and cutting into materials such as brick, concrete, stone, asphalt.

1.12.2 Rammers
Are used for compacting return soil and for compacting hardcore.

1.12.3 Hammers
Are used for cutting holes or chases in brickwork and for bush hammering and similar operations on hard material.

1.12.4 Rotary drills
Are used for drilling holes in all types of materials.

1.12.5 Grinders
Are used for such operations as smoothing down the faces of in situ cast concrete and for grinding down all types of materials.

1.12.6 Saws
These may take the form of a circular or rotary saw, a reciprocating saw, or a chain saw.

1.12.7 Planers and rebaters
Are fitted with two bladed, high-speed rotary cutters.

1.12.8 Routers
Are used with bits of varying profiles for grooving and moulding.

Figure 1.8 Power tools

1.12.9 Cartridge hammers

These are also known as rivet or bolt guns and are used for making fixings to timer, brick, concrete, and metal by means of steel pins.

1.12.10 Sanders

Are used for smoothing down wood surfaces. There are four types:

- rotary or disc sander
- belt sander
- orbital sander
- drum sander (which is used for sanding floors)

The disc and belt sanders can be used with the appropriate types of abrasive discs or belts for metal and masonry surfaces and for removing paints and varnishes.

1.12.11 Power floats

Are used for trowelling screed, monolithic finishes and the surfaces of large areas of concrete. They produce a very dense, smooth surface.

1.13 General rules for the selection of site plant

The selection of site plant is the concern of both contractor or agent and the General Foreman, and general rules which apply to most contracts are:

- Plant should just be able to cope with its commitment, eg do not use a 5 000 kg crane when the greatest load will be only 2 000 kg.
- On a busy site it may be economical to use two travelling derrick cranes each to service a flank of the work in progress. Tall structures in restricted areas are economically serviced by a central tower derrick.
- A concrete chute and a derrick can easily and quickly transport concrete over a wide area.

Note:
Concrete tends to segregate unless the chutes are kept clean.

- Wherever possible the force of gravity should be used.
- Hoists conveniently located around the perimeter of a multi-storey structure save much time in layout.
- Machines should be used where there is much repetition work and manual layout, for isolated operations. It must be the right kind of machine for the job.

1.14 Utilisation

1.14.1 Using plant on site

An experienced person will utilize a machine in the light of the following requirements:

- It must be able to carry out its task economically, and if necessary continuously.
- There must always be sufficient work on the job to keep it occupied.
- There must be sufficient site attendance available to maintain its maximum output, eg if the machine is an excavator, it must have sufficient work to keep it occupied, and be adequately served by trucks running between the site and the dump.

Note:
If only a few machines are required on site, a plant programme may not be essential, but on large contracts where the relative value of

	the plant is high, a programme showing the requirements of it throughout the contract should be drawn up.

The programme for each machine should be adjusted so that output is maintained at as high a level as is possible. Each machine should have its own history card which should be kept up to date.

Such records should include output on site, cost and periods of delay, repairs and the unit costs for operation in terms of petrol and oil and other fuel, and the cost of attendant labour.

It is difficult to arrange that plant is kept fully utilised all the time. The golden rule is that plant not in use shall be maintained in full repair, and the programme arranged so that all plant is kept on site for as short a time as possible. This applies specially to hired plant.

If the plant belongs to the contractor this is not as important a factor, except that it is more convenient if plant is stored in one yard, in order that other jobs may avail themselves of it more easily.

1.15 Types of transport used for haul levelling, excavating, loading, mixing and compacting

1.15.1 Dumpers

Useful machines, powered by diesel engines, with a wide range of sizes of forward tipping skips. They are designed with rear wheel steering, are very manoeuvrable and travel well on the rough and muddy building sites.

Various specially shaped bowls can be fitted to carry concrete, rock or lightweight materials, and most types can be adpted and licensed for work on public roads.

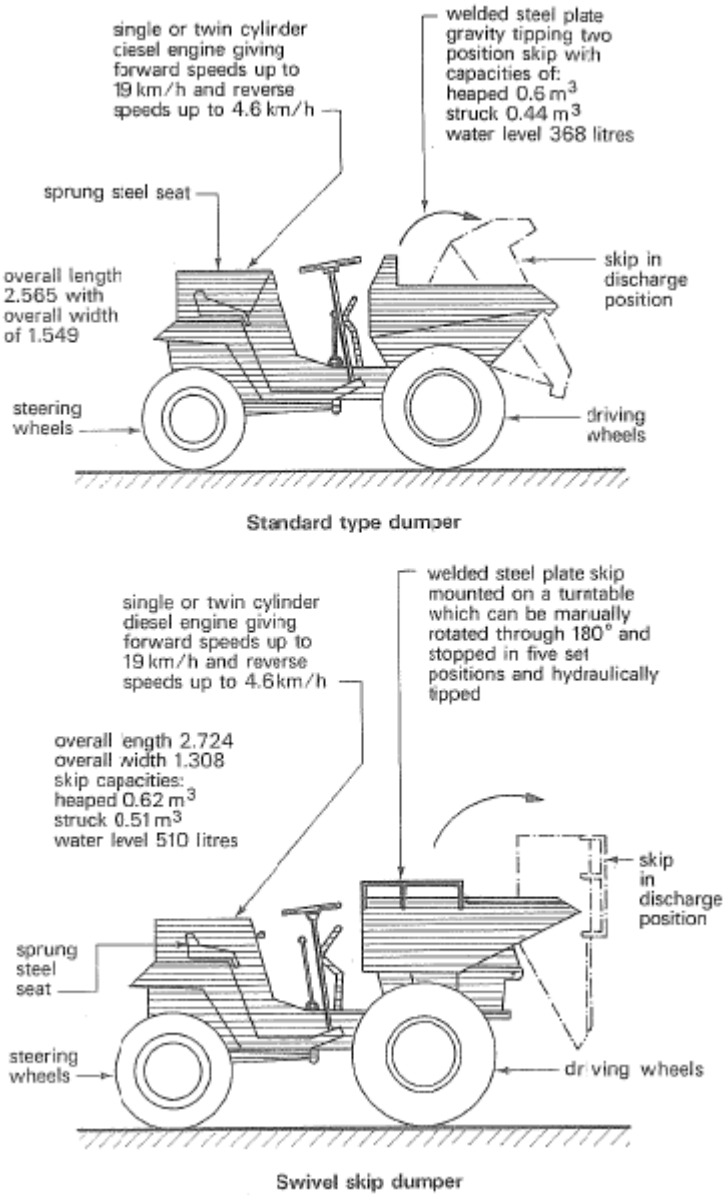

Figure 1.9a Typical dumper details

1.15.2 Dump trucks

These are specially designed for hauling excavated materials on or off the highway. They are fitted with high-capacity metal bowls that are designed for easy filling and quick, clean tipping.

The bowls are mounted on robust steel chassis, usually have four-wheel drive and discharge their loads by tipping to the rear. The capacity of these trucks varies from 3 to 50 m^2.

Figure 1.9b Highway dumper

1.16 Compacting equipment

1.16.1 Rollers

The roller is designed to compact earth and consolidate filled materials to form a good solid foundation for roads, runways, buildings, etc.

a. Solid wheel rollers

Powered by diesel engines and their weights range from 1 to 16 tonnes. This weight is distributed over the two large diameter solid wheels.

The degree of compaction obtained from them depends on the weight, which can, in some designs, be varied by using ballast of some kind.

Rollers of this type also carry water tanks for the dual purpose of ballast and supplying small sprinkler pipes mounted above each wheel. These sprinkle water on to the wheel which prevents tar and similar materials from sticking.

b. Tamping roller

This is a self-propelled machine fitted with two or more steel rolls. A number of tapered steel projection are fitted to the surface of each roll.

The projections produce a tamping action which is more effective at higher speeds. The tamping effect, together with the pressure exerted makes the roller suitable for large areas of course granular material, eg rock fill.

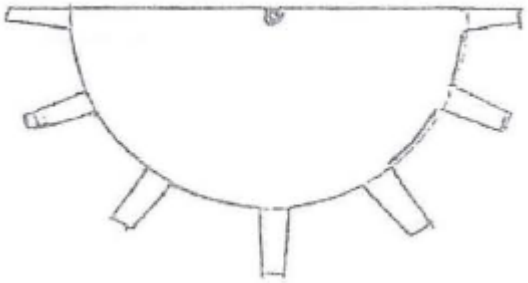

Figure 1.10 Projections on roll of tamping roller

c. Vibratory roller

This machine has one or more steel rolls, to which vibration is applied by a separate vibratory unit.

It may be self-propelled or towed to enable large areas to be compacted. A smaller version, which is powered but manually guided, is used in confined areas. The vibratory roller is most suitable for compacting granular material, but in can be used effectively of other types of material.

d. Pneumatic-tyred roller

This machine consists of a large box filed with ballast which is supported on two axles in such a way that those on the rear axle are behind the gaps between those on the from axle.

Each wheel is independently sprung so that all the wheels remain in contact with the ground. The roller may be self-propelled or towed. It compacts by pressure alone, and is suitable for large areas of granular material.

Figure 1.11 Layout of wheels for pneumatic-tyred roller (Sheepsfoot)

e. Sheepsfoot roller
This machine is similar to the tamping roller, but the projections are shaped like sheep's feet, ie club-shaped. The sheepsfoot roller travels at a slow speed to reduce the tamping effect, and the shape of the projections produces a kneading effect. This enables cohesive soil to be compacted without the material squeezing out from beneath the rolls.

f. Vibrating plate
This is a steel plate, to which a vibratory unit is attached. It is manually operated, and used for compaction in confined spaces where access for a roller is difficult.

1.17 Excavators

1.17.1 Universal excavators

The universal excavator is perhaps one of the best-known pieces of builders equipment in general use.

The cabin of the excavator is built onto a turntable mounted on crawler tracks and allows the machine to work through an angle of 360 degrees. All the operations of the excavator are controlled by the driver from a set of controls inside the cabin, which also houses the engine. All movements are hydraulic controlled.

1.17.2 Skim shovel

The basic design of this shovel is a straight job, hinged from the front of the cabin, on which is mounted an opening bucket.

This bucket works up and down the jib and is used for skimming off surface soil. The shovel can also be used for loading loose material. It has the disadvantage that it cannot excavate more than 300 mm below the level of the machine's tracks.

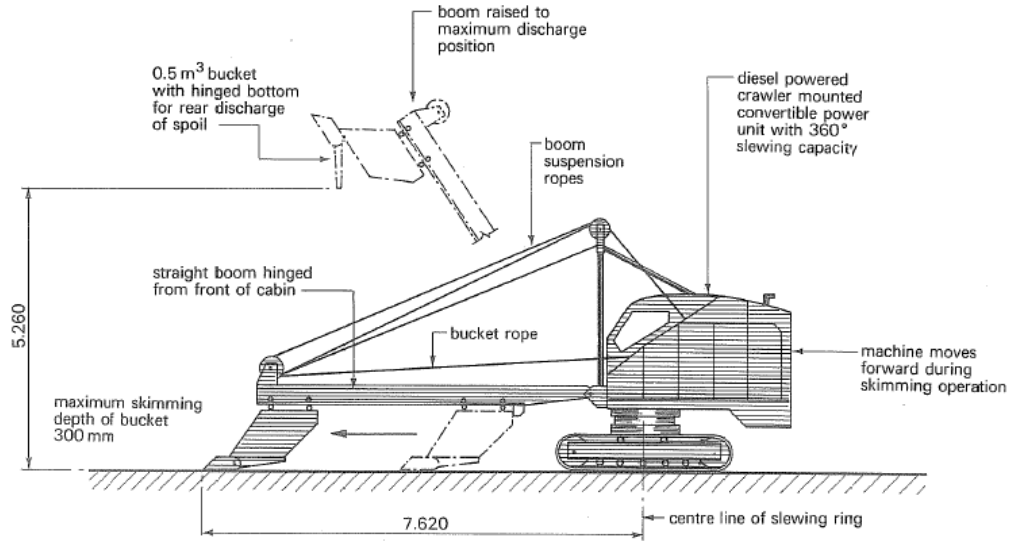

Figure 1.12 Typical skimmer details

1.17.3 Grab shovel
Grabs are usually employed for handling loose material, for instance, for feeding concrete batching plants, and are rarely used for excavating.

1.17.4 Loading shovels
Loading shovels are similar in design to tractors and have 1 m^3 to 2,5 m^3 buckets, operated by hydraulic rams mounted on the front.

The majority of these shovels are mounted on rubber wheels and so they are only used for loading loose materials.

1.17.5 Multi-purpose excavator
This machine has a tractor shovel attachment fitted to the front, and a back-acter attachment, fitted to the back, thus providing the facilities of two machines. This is particularly useful on congested sites, where access onto, and off, the site is difficult. Most machines are on wheels.

The machine, however, is fitted with stabilisers at the rear end and, when working as a back-acter, it is supported on these stabilisers and on the tractor shovel bucket, which is laid on the ground.

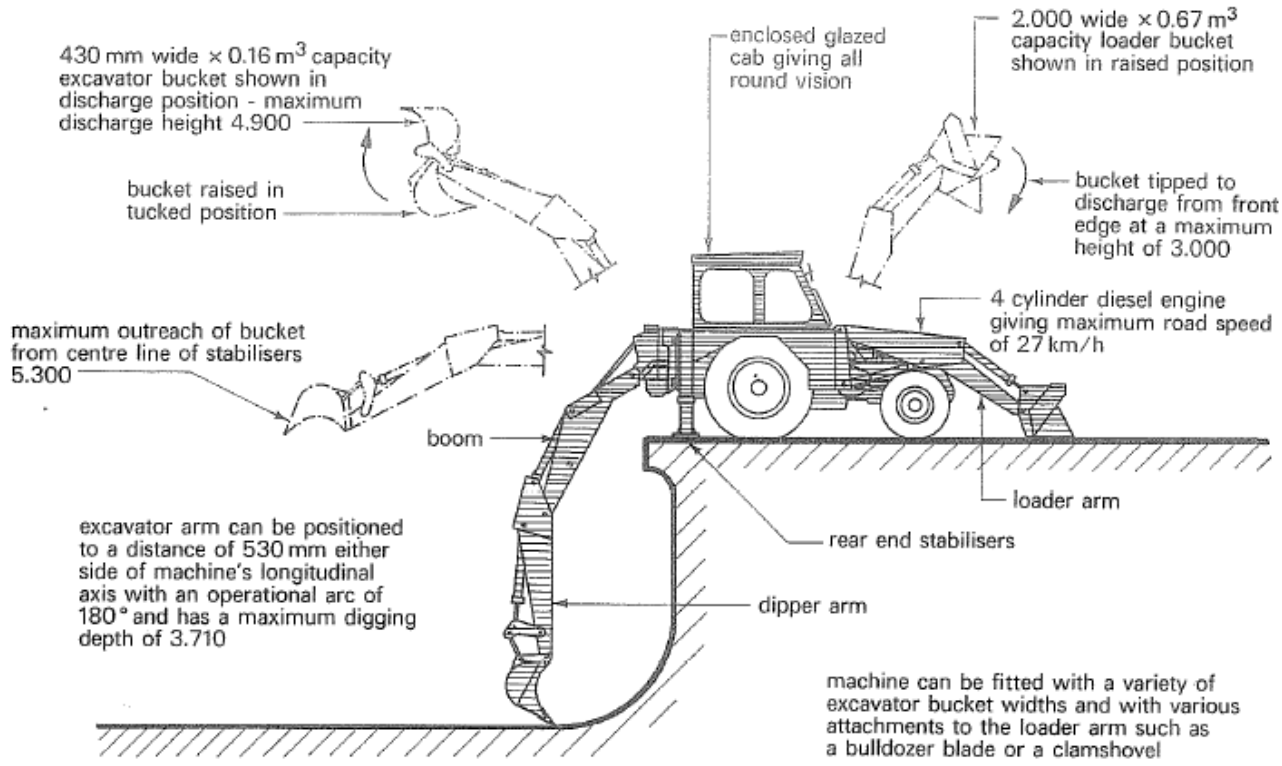

Figure 1.13 Typical excavator/loader details

1.17.6 Continuous loaders or trenching machine
A common type is the bucket-wheel excavator. This works in vertical faces, and can be used in unconfined areas or in trenches. A series of buckets rotating on

a horizontal shaft dig into the face and deposit the excavated material on a conveyor belt.

Continuous loaders are capable of very high output in good conditions. However, the sophisticated nature of such machines makes them somewhat prone to mechanical failure.

Figure 1.14 Trenching machine

1.18 Earth-moving equipment

When earth and similar materials have to be moved great distances on site, an excavator is not always the best unit to use, and tractors, bulldozers or scrapers may be introduced to carry out this work.

1.18.1 Bulldozer

It is a tractor, to the front of which is fitted a blade. Forward motion of the machine enables loose material to be transported over short distances by pushing it. The blade is slightly concave, and may be fitted with sidepieces to help confine the material being pushed.

It is capable of being raised above the level of the machine's base. Hence, by forward and backward motion, carried out.

A development of this machine is the angle dozer. Its blade, in addition to the vertical movement, can be rotated to some degree about both major horizontal axes; this provides greater flexibility.

Note:
Much of the work carried out by the bulldozer demands considerable traction, and the machine is usually on tracks.

Figure 1.15 Bulldozer

1.18.2 Tractor shovel

This machine, also called a loading shovel, is a tractor to which a container (the bucket) is fitted by a pair of arms, which are hinged to the body of the machine. By rotating these arms, the bucket can be moved from a position in front of the machine to a position above it.

The bucket can also be rotated about its own horizontal axis. The bucket is fitted with a cutting edge; its capacity is usually in the range 1 - 8 m^3.

The machine is used for all types of excavation above the level of its base, and for transporting material over moderate distances. It may be on tracks or wheels depending on the circumstances in which it works, and the required length of haul.

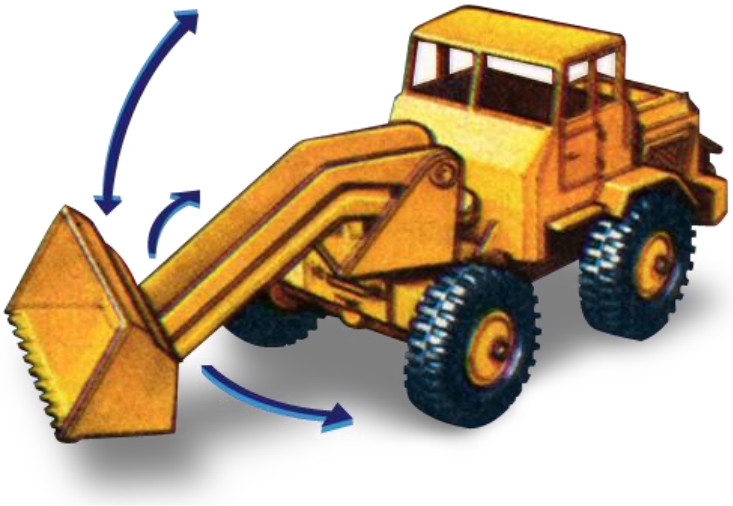

Figure 1.16 Tractor shovel

1.18.3 Scraper

This machine is an articulated four-wheeled machine, consisting of a large container (the bowl) and a power unit. Its purpose is to excavate large quantities of material in unconfined areas, to transport it to medium and long hauls and to deposit it. Capacities are normally in the range 5 - 40 m^3.

The bowl is approximately rectangular in plan. The side walls are fixed, but the whole bowl are all capable of limited movement; such movement is activated hydraulically from the power unit. The front of the base if fitted with a cutting edge.

Figure 1.17 Scraper

1.18.4 Graders

When large areas of ground have to be finished to finished to fine limits, graders are used. These machines are similar in design to bulldozers in that they carry long, slender, adjustable blades for levelling purposes.

The long narrow blade slung under the centre of the machine and can be fixed in various positions, through an angle of 300 degrees.

This makes the grader a most useful machine as it is able to grade to levels in the horizontal position and also on sloping banks, with the blade in an inclined position.

Figure 1.18 Grader

1.19 Selection of mechanical plant for various purposes

Before plant can be selected for any excavating work the project must be analysed.

This should consider the following points, related to the job in hand:

1.19.1 Load

This refers to the type, condition and amount of material to be excavated or moved. Manufacturers are able to offer information on any specific machine.

The percentage of swell show the approximate increase in bulk which can be expected when the material is excavated.

1.19.2 Haul and return
The type and length of the haul roads together with their conditions. These points govern the speed of haul and subsequently the number of units required.

1.19.3 Dump
Points to be decided are the purpose of the dumping or tipping area once the contract is completed, and the conditions of the material to be dumped and the size of the tipping area. If the dumping area is to be used later to form a road foundation, rolling equipment will be required.

1.19.4 Spotting
This final point takes into consideration the ability of the haul unit to position itself under the excavator bucket in such a manner that maximum hourly output is possible.

The excavator should only be allowed to swing through an angle of 45 degrees, from dig to the haul unit to maintain maximum output. If this angle is increased for any reason the hourly output of the excavator is reduced.

1.20 Cost of excavating
Before any cost can be estimated, the hourly ownership costs a particular machine must be obtained. The method of arriving at such a cost is shown.

Points to be considered:
- Depreciation
- Insurance and Interest
- Maintenance, tyres included
- Fuel, oils and grease
- Wages
- Rise in cost of new machines

1.21 Costing
Accurate costing of civil engineering construction work is very difficult.

Definition: Costing
Finding the cost of undertaking separate classes of work such as concreting, bricklaying, shuttering, etc, or finding the cost of undertaking separate parts of a job such as the cost of access roads, subsidiary buildings, main building, installation of machinery, etc.

The foreman must fill in daily timesheets which can be used for costing the labour.

The allocation of charges for materials present difficulties since the paperwork on site usually is concerned only with checking the inflow of materials against

the suppliers' invoices and none of the basic records may show where the materials have been used in the separate parts of the job.

The bill of quantities measurements may be of assistance for calculating quantities of materials used in the permanent works, but here are many materials, such a timber for shuttering, scaffolding, small tools, diesel, oil, nuts and bolts, etc. which are not used in the measurements records. These also have to be charged as part of "site-on-costs".

Provided plant hire charges are know, the allocation of plant charges is relatively easy on the basis of the daily returns of plant usage rendered by the foreman.

In addition to the above, it is necessary to add the various site administration charges to the account for site on-costs, such as wages of the geneal foreman, engineers, site clerk, agents, etc., together with all such other charges as telephone, water supply, sanitation, insurance of works, petty cash, etc.

The practical headings under which a contractor can expect to analyse his expenditure ware more likely to be:

- gross wages paid
- transport of men
- non-productive hours
- materials used in permanent works
- materials used in temporary works
- materials used in shuttering
- equipment
- scaffolding
- stores
- fuel and power
- plant hire
- plant repairs
- temporary offices and services
- site staff and administrative expenses

Thus, the prices submitted individually in a bill of quantities contract may not represent the actual separate cost to the contractor of such items, but together they should represent the total expenditure to be incurred, including an allowance for profit.

1.22 Plant and vehicles

Plant plays an increasingly important role in building operations and both time and money can be saved by the efficient use of mechanical aids. Yet the full advantage can only be obtained if the plant is well managed both on and off the site, and this requires a thorough understanding of the economic aspects of using plant and vehicles.

- Further mechanisation of erection is largely influenced by design, for the machine needs mass production to pay off. For example, a crane will become expensive if the design does not allow daily continuous programmes of work while it is on the site.
- As a large proportion of the fixed capital of the building industry is absorbed by plant, it becomes important that it should be used to its full working capacity and well maintained, in order to pay for itself and help reduce construction cost.
- All these factors underline the necessity of obtaining the true operating cost of plant.

  The following are guidelines for calculating and comparing costs.
  - The working life of any individual item of plant will depend upon its typical characteristics, on the way it is used and how it is maintained.
  - The hire charge is to be levied upon the time it is available for work on a contract.
  - Market depreciation must be allowed for.
  - Obsolescence must also be borne in mind for new models may be produced with lower relative operating costs.
  - Replacement costs should make allowance for inflation because prices often change fairly rapidly so that the schedule of annual charges may have to be revised annually.
  - The standard of maintenance and the length of life obviously are related. Maintenance cost must therefore include labour, material and full plant department overheads.
  - An annual addition must also be made for insurance, licences and administrative overheads.

1.23 Maintenance

Reliable plant is essential if building and civil engineering work is to be carried out at a rapid rate of progress, at low unit cost and without serious danger to personnel.

Systematic maintenance is therefore a matter of prime importance, and since both the life and the serviceability of the plant depend to a large extent upon the correct performance of this routine work, effective supervision both in the workshop and on the site is very necessary.

Thus, whatever the size of the firm, the efficient organisation of the plant department is a vital responsibility.

1.24 Repair depot

It is the normal practice of contractors who possess sufficient plant, to maintain their own yard for storing plant which is not in use, and to employ a plant engineer and fitters for minor repairs and general maintenance.

Heavy repairs and major overhaul s may be carried out by the makers or specialist firms, but the basic requirements of a depot include the following:

1.24.1 Workshop facilities

Workshop facilities may begin with the minimum of covered accommodation and a concrete floor, with provision for heating and lighting, particularly for night working.

Equipment such as benches, hand tools, lifting tackle, welding gear and small power tools may progress to include air compressor, battery charger, lathe, drill, etc., as the depot grows.

1.24.2 Spare parts

Spare parts must be readily available in order to reduce site delays and a good service might provide complete assemblies as a service exchange. The size of the store and the variety of quick-wearing parts are decided on the basis of experience and from repairs records, but standardisation of machines can help to decrease the range required.

1.24.3 Records

Records are necessary to indicate the progress of the work that is being undertaken and to ensure that the history of each machine is registered and the statistics can be reviewed. A chart showing the location of plant on the various sites and their state of serviceability should be checked daily.

1.25 Site servicing

The first stage of maintenance consists of regular attention by the operator to ensure that such items as cleaning, oiling and greasing, tightening loose nuts and bolts, etc, are in order.

Note:
Daily routine checks must be made of water, oil, fuel, lights, tyres and brakes (for vehicles), while weekly servicing instructions can be incorporated into the drivers' log book to ensure complete coverage.

The principle of "one man to one machine" should be applied as far as possible. Breakdowns will, however, occur on even the best organised site, and unless a stand-by is kept available for immediate repairs, the services of a full-time mobile mechanic will be required.

In addition to making minor repairs and adjustments, the mechanic should also inspect the plant to see that maintenance is being properly carried out, and his selection and training are therefore most important.

1.26 Preventive maintenance

Regular inspection by a competent mechanic is the next stage, in order to ensure that machines are kept in good working order and thus reduce the number of breakdowns.

These checks should preferably take place outside working hours, eg at weekends, otherwise the plant will need to be withdrawn at agreed intervals for this purpose.

Checklists should be prepared, listing the items to be inspected or adjusted for particular frequencies of mileage or running hours.

1.27 Planned maintenance

A maintenance inspection may reveal the need for a future major repair, or a periodic overhaul in a workshop may be due when the machine will be completely stripped down and any worn parts renewed.

CHECK LISTS
PLANT NUMBER ..... TOTAL OPERATING HOURS .....

Check and correct where necessary , the following items.

Tick if correct ,
(A) if adjustment is made,
(X) if repair is needed, with details.

1	ENGINE - check for	
	oil leaks	( )
	oil pressure	( )
	loose holding-down bolts	( )
	tank-holding bolts	( )
	filter, and covers	( )
2	ELECTRIC MOTOR - check	
	Holding-down bolts	( )
	conduit for breaks	( )
	slip-rings for arching	( )
	brushes	( )
	protective covers	( )
3	ELECTRIC STARTER - check	
	Contacts	( )
4	PUMP - check	
	water leak at gland	( )
	water leak at petcocks	( )
	water leak at damaged pump	( )
	cracked or damaged pump	( )
	loose bolts	( )
5	STAND OR CHASSIS - check	
	Cracks	( )
	damaged wheels	( )
	washer and retaining pins	( )

ADDITIONS

.....

.....

.....

MECHANIC .....

DATE .....

Figure 1.19 Check lists

Arrangement for this work and planning so that the minimum production time is lost, the available workshop resources are not over-taxed, and that the anticipated replacement parts are in stock, constitutes the second leg of systematic maintenance known as planned maintenance.

PLANT RECORD AND COST SHEET

Contract ..... No. ..... Machine ..... Week Ending .....

ITEM No.	Description	Hours	Total hours	Hire cost		Fuel cost		Total cost	
				R	c	R	c	R	c
Standing time									
Breakdown time									
TOTAL TIME COST									

CONSUMABLES

		Total quantity	Rate per Unit	Cost	
				R	c
Fuel					
Oil					
Grease					

PLANT-REQUIRED CHART

Contract ..... No. .....

Plant item	2010				2011						
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Excavator											
Concrete mixer											
Hoist											
Skid shovel											
15 x 6 m Site office											
15 x 6 m Store											
Toilette											

Figure 1.20 Plant record and cost sheet

Activity 1.1

1. List and describe the different types of plant used for leveling, excavating, loading, mixing and compacting.
2. Write down a brief explanation of the plant and it's utilization.
3. Explain how to select mechanical plant for various purposes.
4. Explain the meaning of the following:
   a. Sequence utilization
   b. Maintenance
   c. Servicing

	**Self-Check**	
I am able to:	**Yes**	**No**
• Describe the types of plant used for:		
o Levelling		
o Excavating		
o Loading		
o Mixing		
o Compacting		
• Give a brief description of the plant and it's utilisation		
• Describe the selection of mechanical plant for various purposes		
• Describe the following:		
o Sequence utilisation		
o Maintenance		
o Servicing		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 2

Progress Charts and Schedules

Learning Outcomes
On the completion of this module the student must be able to:

- Define the different types of progress charts and schedules
- Explain the different methods of recording on charts
- Describe the following loading schedules:
  - Mechanical equipment
  - Plant loading

2.1 Introduction

This section discusses the importance of having a programme which consists of progress charts and schedules.

Definition: Programme
A sequence of action steps arranged in the priority necessary to accomplish an objective. Synonym: series or sequence of activities.

Definition: Programme step
An individual action step that is part of a larger programme. Synonyms: activity, task.

Definition: Schedule
A time sequence arranged to carry out a programme.
Synonyms: time estimate, activity time.

Definition: Management programming
The work a manager performs to establish the sequence and priority of action steps to be followed in reaching objectives.

Definition: Management scheduling
The work a manager performs to establish the time sequence for programme steps.

2.2 The logic of programmes and schedules

Important as it is to know where we are going it it is also desirable that we determine the best way to get there before we begin to commit people, materials and facilities. This is particularly important if we want to integrate our action with that of other people and units.

It is unlikely that the total work of the team will be co-ordinated if each individual is intent on doing what he wants to do, according to his own preferences. Before we undertake action, we should establish the sequence and priority of the steps we must accomplish to achieve the end result.

Time is also an invaluable asset; how can we make the best possible use of it? We can either do each thing as it comes up, carrying out each step as promptly and efficiently as we are able, and hoping that we will be successful, or we can think the matter through beforehand and establish a time sequence for each activity that will enable us to complete the action within the allocated time.

Note:
Programming provides us with a means of exploring the alternative routes to our proposed goal and of deciding the specific steps that will get us there in the most effective and economical fashion.

A programme is a series of action steps that must be carried to reach an objective. Each programme step requires the expenditure of mental and physical effort or work. usually we must utilise the time of people, materials, tools and facilities to carry out the programme, which means that we can determine cost in terms of money.

Scheduling provides us with a tool for making the best use of the time available. When we schedule, we determine the time available, we can reconstruct our programme and schedule mentally and on paper, rather than carrying out the action and using up the time and only then discovering that what we have done is inadequate.

The programme and schedule set priorities by listing the action steps to be taken in order to their importance. They enable us to bring the greater part of our resources to bear against the few important things that must be accomplished.

At the same time, they throw into proper perspective the less important details which may be contributory but which can also consume energy and expense out of all proportion to their real worth.

If we do not programme, we tend to do whatever seems most important at the time. It is easiest to do the small, routine things first. In consequence, we push the major problems back and never seem to get to them. We become overloaded with detail and emergency matters.

Unfortunately, the more fire fighting we do, the less time we have for management planning .

2.3 Advantages of programmes and schedules

Properly prepared, the programme and schedule become administrative tools of great value to every manager. Used together, the programme and schedule force him to weigh and assess his alternatives for action and to put greatest effort behind his most important problems.

Because they bring into focus potential problems before they become emergencies, they enable him to develop, ahead of time, the alternatives and possible answers to these problems and to marshal his resources and facilities so that he can take the most action.

Programming greatly facilitates co-ordination of the operation, of different organizational units. If a all managers engaged in a common activity have thought through beforehand what they are going to do and have committed their programme to writing, it becomes a relatively simple matter for each to compare his projected activities with the other and to reconcile differences where they occur.

Note:
The programme and schedule are also the basis of effective control.

Once a manager has decided the specific steps he expects to complete and the time required, he can use this expectation as a yardstick against which to ensure his progress.

By reporting the progress made in comparison with his progress. Once he has approved the overall programme for his unit, the manager has established limits within which each individual subordinate manager can be delegated a large measure of authority to develop his own methods of getting the job done.

Since the programme and schedule envisage the total requirements of the unit, they anticipate and prevent overlap and duplication of work by different managers and give each a clear-cut charter within which he can proceed with assurance and initiative.

2.4 How to programme and schedule

Programming can be accomplished most effectively if it is carried out systematically . The following is used effectively by many companies.

2.4.1 Review objects

Each programmed step should carry us towards the end results we want to accomplish. Therefore, as a first step, we should review our objectives, making sure that we have clearly in mind the overall result we want to accomplish. To repeat, if we do not know where we want to go, we can hardly decide how best to get there.

2.4.2 Determine major steps

We should best block out the most important steps we must take to reach our objectives. The major areas of accomplishment should be considered, and we should not become bogged down in detail. The natural tendency to work out each step as it comes to mind should be avoided.

Our purpose now is to lay out the course as a whole. Later we can come back to work out the detail, or we can delegate this to others.

2.4.3 Establish priorities

Now we have determined the major action steps that must be taken. Since there are probably not all equally important, we shall now want to establish priorities. Certain things have to be done before others so as to work towards a cumulative end result.

For example, we must elect an train people for a new project before we get the project itself under way. When in doubt, a useful criterion is: What contribution does this particular step make toward accomplishment of the objectives I have set?

Note:
The more important the contribution to end results, the higher the priority.

To some extent out priorities will depend upon the time we have available.

Therefore, this step and the next will follow closely upon one another.

2.4.4 Schedule

We now look to timing. The first step here is to determine the time limits within which we must work. One approach is to begin at the end point and work back. If we know when we must be finished, we have the best means of determining the total time available and how best to allocate it against each of the major steps we must take.

In some cases we shall be attempting to meet deadlines set by our superior, or by other agencies in the organization .

2.4.5 Determine detail

Once we have the major area of accomplishment blocked out, together with the timing, we can establish the detail steps. In these cases where major steps pertain to one subordinate unit, we may want to delegate the detail in full to the accountable manager of that unit, asking him to work out with his people the detail steps together with the attendant schedule. When we do this, he should be given as wide a latitude as possible.

Our prime concern should be to establish what has to be accomplished, delegating the how as largely as possible.

2.4.6 Review and reconcile

As a final step, all programmes should be reviewed and reconciled to ensure that they are integrated and unified for best accomplishment of the overall result. This review and reconciliation can be accomplished at a committee meeting.

When this approach is used, we should be sure to give each committee participant copies of the overall programme and schedule to study beforehand so that he can come prepared. It is poor practice to ask committee members to review data or assemble information during the meeting.

2.5 The need for planning

Planning is a fundamental necessity in any civilised society. Without it, getting a specific result by a definite date is a matter of chance. If success is to be assured, national economic planning has to be developed up to ten years in advance.

Note:
Planning is a continuous process and must be sensitive to change, flexible in approach and vigorous in application.

2.6 Planning in the building industry

2.6.1 Activities

The prudent building contractor, like a business proprietor, starts his activities with a plan. The builder has to find answer to such questions as:

- What proposed building projects are there for the next five to ten years?
- What type of construction, ie flats, houses, factories, shops, etc is wanted?
- Is building land available?
- Are there prospects for development?

2.6.2 Financial budget

A sales plan can be formulated from this information, and it will be aimed at achieving a reasonable mixture or balance between the various types of work.

At the same time as the sales plan, a financial plan must be developed which will require answers to such questions as:

- How much capital is available?
- What proportion of the capital is in fixed and in liquid assets?
- What credit or overdraft facilities exist?
- How many times is it anticipated the capital employed will be turned over in the financial year?
- What is the percentage profit on turnover?

A financial plan can be developed from the answers to these questions and will probably be expressed in the form of a budget for the successive trading years.

2.6.3 Personnel

Consideration must now be given to the personnel who will provide for the manpower, the managers, accountants, technologists, technicians, craftsmen, unskilled workers, clerks, etc. Again a number of questions require to be answered:

- Is staff available or must they be recruited?
- What form of advertising will be necessary and where should it be?
- What training or development of personnel will be required?
- What form of organisational structure will best suit the sales plan?
- The areas of responsibility and authority require defining?
- A salary scale structure will need developing?

More plans have to be prepared covering such subjects as plant and equipment, offices and purchasing, until the whole organisation has been thought out.

The task of production planning begins when these essential exercises of management planning have been performed and the sales policy is yielding a flow of enquiries for tenders and then contracts.

2.7 Production planning

Production planning in the building industry generally falls into three distinct stages:

- Pre-tender planning
- Contract planning
- Detailed, stage or period planning

2.8 Pre-tender planning

In tendering for a contract, a building contractor finds himself committed to a time limit in which he is required to complete the contract.

This time limit is, in most cases, so important to the owner that to enforce the required contract period being complied with he has inserted into the conditions of the contract a penalty clause governing late completion of the

contract. The time in which a project is to be completed should therefore be carefully considered when a tender is being prepared for submission.

Pricing and planning are closely connected in most of the individual items in the bill, with the preliminary items required in the initial stages of the work on site priced directly in relation to the time they are required.

Note:
The basis of estimating is one of cost balanced against time to achieve the lowest overall cost consistent with the shortest contract time.

This balancing process invariably involves co-ordinating the work of the contract, and at this stage already it will be found necessary to record the various schemes with their appropriate methods, sequences, times and cost.

It is also the important purpose of enabling the contractor/tenderer to compare his organisation with that necessary to complete the contract and judge whether it is of sufficient capacity to handle the proposed work.

2.8.1 Objectives of planning

The programme, to be effective, must be drawn up with the following objectives:

- The quickest and most economical way of doing the work based on available resources.
- The proper phasing of operations with balanced labour gangs in all trades, to ensure continuous productive work for all staff employed and reduce unproductive time to a minimum.
- Determination of attendance dated and periods for all subcontract work.
- Provision of information on material quantities and essential delivery dates, the amount and capacity of plant required and the period of use on site.
- The provision, at any time during the contract, of a simple, quick method of measuring progress for the builder's information, architect's certificate, or the valuation of work for accounting purposes.

On being invited to tender, the contractor will be provided with the necessary tender documents which may comprise a bill of quantities and a specification, together with certain drawings.

A specific time will be allowed in which he has to establish and submit his tender price.

The work is divided into two sections comprising the pricing of the bill (costing phase) and the preparation of the pre-tender plan (time phase).

All relevant information is prepared in a systematic manner often called “Tender Appreciation” and should include the following items:

- Access to the site
- Existing underground and overhead services
- Labour availability in the area
- Availability of electric power, type of loading
- Time allowed for contract
- Brief method appreciation covering bulk items of work:
  - Excavation: recommended machines and/or equipment
  - Concreting: type of mix, quantities, method of mixing
  - Brickwork: quantity and quality of types of work
- Scaffolding
- Site requirements - offices , stores etc
- Drawings available at the time of tender

With the tender appreciation phase completed, the two major stages of the pre-tender planning can commence, namely, the pricing of the bill and the preparation of the pre-tender plan.

PRE-TENDER PROGRAMME

CONTRACT ..... NO. .....

ITEM	YEAR	2010										
	MONTH	1	2	3	4	5	6	7	8	9	10	11	12
PRELIMS													
EARTHWORKS													
PILING													
DRAINAGE													
CONCRETE REINFORCEMENT UP TO G LEVEL													
CONCRETE REINFORCEMENT ABOVE G LEVEL													
ASPHALT													
CARPENTRY AND JOINERY													
PLASTERING													
PLUMBER													
ELECTRICAL WORK													
FLOOR COVERINGS													
PAINTING AND GLAZING													

Figure 2.1 Pre-tender programme

A contract programme can be drafted in outline for a scheme on a monthly time scale with only the major items of work considered. A typical programme is illustrated in **Figure 2.1.**

Each item is plotted in relation to all the other work, such as draining running under basement slabs which must be completed before the slab can be cast and finished. The length of each bar line is determined by using information obtained during the tender appreciation stage coupled with the quantities reflected in the bill.

Analysing the programme illustrated in **Figure 2.1**, we find it having been build up as follows:

a. Excavation
Excavation = 2 500 m^3 (quantity measured in bill)
Rate of machine = 20 m^3 per hour
Time required = $\frac{2500}{20}$ = 125 hours = 3 weeks
Allowance for hand trimming = 1 week
Total = 4 weeks

b. Piling
Piles No 75 (quantity measured in bill)
Rate of piling = 8 piles per rig per week
Time required using one rig = $\frac{75}{8}$ = 9,5 weeks
Time required using two rigs = $\frac{75}{2\times8}$ (say) = 5 weeks

So the time factor is calculated in draft form for most of the major items of work in all trades and, where possible, estimates of time obtained from sub-contractors when requesting them to quote for their work.

The draft programme is then completed and checked so that the final completion date, as well as any stage completion dates are satisfactory. In this way the pre-tender stage programme is built up so that work can flow evenly and the amount scheduled for each month follow and orderly pattern.

When the tender based on this planning, plus cost comparisons, is finally completed it is submitted, and at a later stage, should the contractor concerned be the successful tenderer, used to form the basis of the actual contract plan which should follow on the acceptance of the tender being confirmed.

2.9 Contract planning

Once the tenders have been received and examined, a contractor is selected and asked to undertake the work.

As soon as the contractor learns that he has been successful in securing a contract, he will plan to start organising and planning for the work that lies ahead.

Contract planning can be said to comprise five main stages:
1. Preliminary negotiations
2. Labour requirements and site organisation
3. Preparation of contract programme
4. Site lay-out and ancillary arrangements
5. Setting up a reviewing and co-ordination system

2.9.1 Preliminary negotiations

As soon as the contractor learns that he is to undertake the work, he will have to establish a procedure whereby information can be passed easily between architect, client and contractor.

This procedure for contract communications is usually in the form of a series of meetings to be held at regular intervals throughout the progress of the contract. The contractor needs all information in order to prepare his contract programme.

When complete, the programme is sent to the architect or consulting engineer for his approval, and this serves as a basis for contract procedure.

2.9.2 Labour requirements and site organisation

These involve senior management initially in the appointment of the planning team, to whom is then delegated the necessary authority and responsibility of planning and organising.

Their first task is an analysis of the construction work and the establishment of labour requirements. The analysis is important, as it provides the information for the contract plan.

Once it has been completed, a labour requirement chart is prepared. The analysis is based primarily on the bill of quantities, by summarising the quantities of work measured into the several main groups suitable for the preparation of the programme at a later stage.

In the preparation of the labour requirement chart, man-hour values are set against these main items of work, which can be easily converted into man-weeks. Labour figures are calculated and set against a time scale to show the number of men required or employed on site at any one time.

CONTRACT LABOUR REQUIREMENT CHART

Contract ..... No. .....

TRADE	2010				2011						
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Carpenter	4	4	6	8	12	12	10	6	4	4	2
Bricklayer			8	8	8	8	8	8			
Steel-fixers		6	6	6	6	6	3				
Labourers	2	2	3	3	10	12	8				
TOTAL OWN LABOUR	6	12	23	25	36	37	29	14	4	4	2
Plumbers						7	8	5	3	6	2
Electricians						5	4	3	8	4	1
TOTAL SUB-CONT. LABOUR						12	12	8	11	10	3

Figure 2.2

Worked Example 2.1

38 mm thick flush panel door 0,8 m x 2,0 m covered both sides with ply and concealed on both edges.

A carpenter, based on past production figures, hangs 8 doors in a working day of 8 hours.

With 1 labourer, 1 carpenter will therefore take for 32 doors $\frac{32}{8}$ = 4 days, or 32 man-hours.

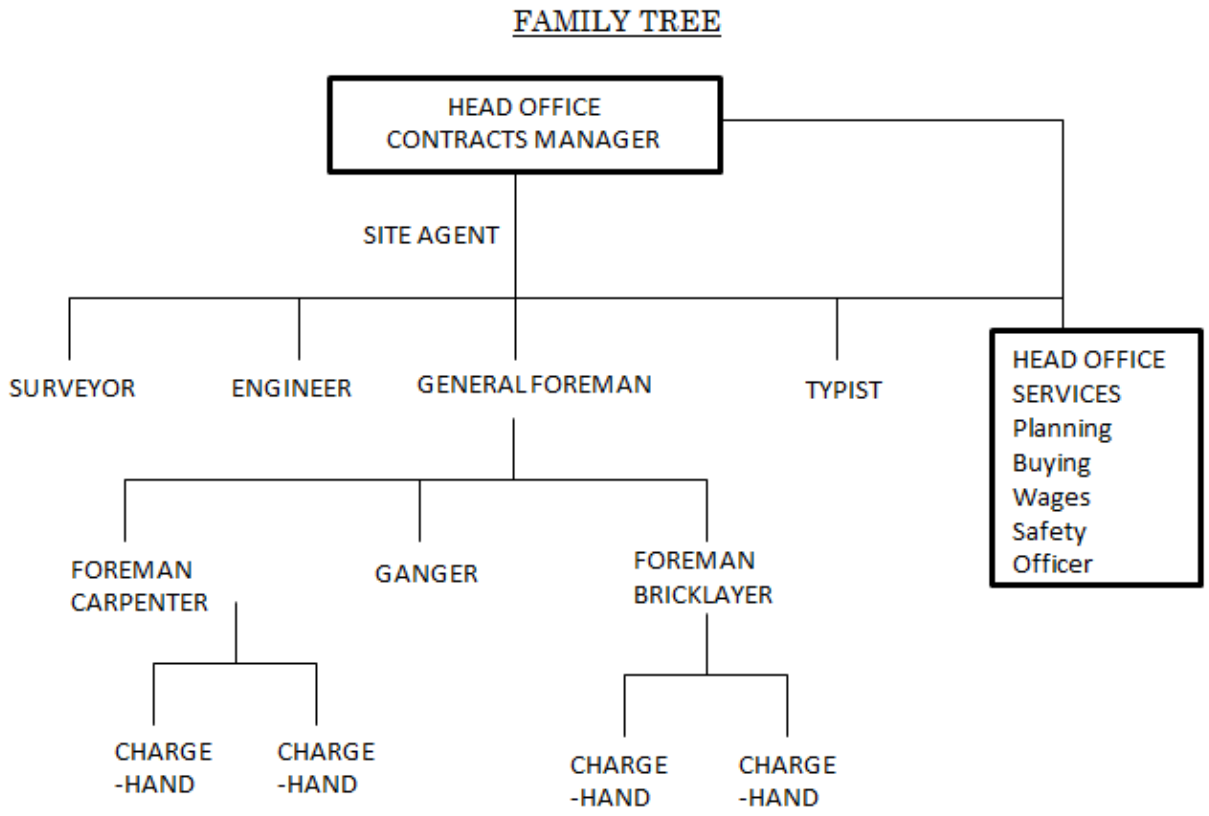

Figure 2.3

2.9.3 Contract programme – Gantt chart

Is the final step of the planning before site construction begins; it is the phase in which a working schedule is compiled on the balanced production in each of the stages, previously dealt with from which programmes and charts have been drawn up.

These are combined to give the final contract programme, which is based on the methods and plant to be used, including this balanced production of work.

CONTRACT PROGRAMME

Contract ..... No. ..... Progress: indicate thus .....

	ITEM	2010				2011						
		Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1.	Preliminaries											
2.	Excavation to reduce level											
3.	Drainage											
4.	External works											
	MAIN BLOCK											
5.	Basement excavation											
6.	Reinforced concrete sub-structure											
7.	1st floor construction											
8.	Brickwork to roof											
9.	Roof construction											
10.	Asphalt											
11.	Plumber											
12.	Electrical											
13.	Heating and ventilation											
14.	Plasterer											

Figure 2.4

The contract programme as it is intended only as a working programme, outlines site operations as a whole, has two objectives:

- In the first place, the preparation of a plan of campaign for the contract, considering sequence and method for all major items of work, and
- The preparation of the information so that it can easily be communicated to the site personnel

It is normally expressed as a programme chart (***GANT CHART***) on which the subdivision of work is shown on horizontal lines and time on vertical lines, with each operation indicated by a bar, the length of which is governed by the time factor.

It can also, in addition, be utilised as a progress chart since it can serve as a means of recording the progress of the work as well.

In preparing the programme the first step is to establish whether the contract scheme used in the pre-tender plan is still valid.

This checking is to ensure that the major plan will still be available and also labour considered at that stage still sufficient.

Important considerations, such as the contract period, cost, and labour availability are more accurately assessed and times allowed for major items of work checked and where necessary adjustments made.

Drawing up a schedule of the main items of work to proceed in the order of priority with those to follow also listed will be a useful step before the bar chart is commenced.

Consideration now, of the method used, together with the priority schedule and the labour requirement chart permits the drafting of the bar chart.

Work items must follow in their correct order and overlapping of operations allowed only if possible in practice.

Note:
The periods of time should not be under-estimated in the preparation of the final programme. If they over-run the contract period, the time periods and the overlap must be reviewed and adjusted to meet the completion date.

If however, the time periods allowed permit completion before the due date, it could be allowed to remain if a bonus clause is applicable to the contract.

If not, it may be an advantage to consider methods of working at lower contract costs requiring the longer time period to ensure completion of the work on due date.

This now brings us to the stage where draft final contract programme can be drawn.

It is subsequently printed and copies are passed to the architect, clients, consultants, sub-contractors, etc.

In addition to the contract programme, a schedule of contract information should be prepared, giving the recommended labour force for each stage of the contract under trades, details regarding the order of operations, details of equipment and methods of construction to be used.

Such a schedule should include full details applicable to all the work to be carried out by sub-contractors. An example of the contract programme drawn up for the same job for which the pre-tender programme (**Figure 2.1**) was compiled is attached to these notes.

Progress control
Progress control and frequency of checking its effect on the work and recording it, are related to the type of planning that has been utilised.

Note:
The detail in which the planning has been carried out will govern the detail the progressing will follow.

By superimposing the actual progress achieved on the contract programme for the project, the immediate relation between it and the programme for the entire project may be seen and thus enable effective control to be maintained at all times.

2.10 Site layout and ancillary arrangements

2.10.1 General principles

The4 stage of contract planning is concerned with the site itself, and there are several major decisions which must be taken at an early stage to ensure the smooth running of the contract later on during the construction period. These can be divided roughly into four groups, although they are independent to some extent.

a. Access Roads

Access to a site is extremely important, because often it will be linked with the plan of construction and, in fact, where the number of access points is limited, it may well control the progress of construction.

Building sites in busy cities may need traffic police approval for their proposals for access and, if island sites, may have to face the problem of one-way streets and traffic circulation. Access about a site is equally important as access to a site and may well influence the methods of construction.

b. Location of major plant

Many items of major plant require special provisions to be made for their installation. They should be positioned where they will cause the least hindrance to adjacent construction, whilst providing the best service.

Tower cranes are an example of this. If they are to be static mounted, they require special bases for the towers which need to be located where they will not obstruct work on the foundations.

If the cranes are positioned within the building, they should be at a point where the towers will also cause the least hindrance to work progressing around it, but it must also be where it will give a radius of cover. All the required lifting or picking-up points.

c. Storage areas and site offices

Dependent upon the methods of construction and the types of materials being used, areas must be set aside for the storage of materials. Of the main

contractors' own materials, the most common are bricks, concrete materials, precast concrete units, timber, reinforcing steel and joinery.

If any of these materials are in short supply, it may be necessary to hold stock levels on site, in which case areas must be set aside for storage. However with the issue of detailed method planning and work study, it is possible to minimise these storage areas. Having prepared the contract organisation chart, it is possible to prepare a requirement for site office space and, where necessary, site canteens.

The location of the site offices is dependent on the individual site requirements, but there are several principles which should be observed wherever possible.

- A situation where there is natural light is an advantage.
- The agent and general foreman would appreciate a location where the contract can be viewed from the window.
- Offices need to be away from the dust and noise of a mixer set-up or batching plant.
- The timekeeper's office needs to be near the entrance to the job.
- Any storekeeper's office or checker's point needs to be in a position where the entry of lorries onto and off the site can be controlled.

The location of temporary buildings, site offices, stores, etc, is a matter of importance and should not have to be moved as the work proceeds. Accommodation should be provided for the clerk of the works, general foreman, etc.

Stores accommodation and plant may have to be moved more than once according to the magnitude of the work, but should be so arranged, especially the materials, that the distance between the stores and their permanent location is as short as possible.

Every effort must be made to avoid unnecessary handling of materials and plant. For instance, double handling of cement an aggregates will increase the cost of the concrete turned out by the mixer.

Note:
Unnecessarily long barrow runs from the mixer to the work will add still further to the cost, and it is no exaggeration to state that the multi-handling of cement and aggregates is frequently the cause of financial loss to the contractor.

Cement and aggregates should be stored where they can be fed directly by road transport and yet near enough to the mixers to avoid further handling. If it is impossible to avoid multi-handling, allowance for this should be made when tendering.

d. Arrangements for temporary service hoardings, etc.
Many ancillary arrangements have to be made at the commencement of a contract and quite a few of these will be in the agent's and surveyor's province.

Arrangements have to be made for the installation of power and water supplies and orders placed with the respective authorities for this work.

If a hoarding is required, the materials must be ordered and labour arranged for its erection. Much of the information contained in the pre-tender appreciation will be of assistance at this stage.

It cannot be stated too strongly that the builder should, before commencing his work, make himself thoroughly acquainted with the requirements of the ***LOCAL BY-LAWS***.

Copies of these are obtainable in the various provinces, cities and towns for a small fee.

2.11 Reviewing and co-ordinating system

2.11.1 General principles

I t is desirable that much of the planning so far described should be complete before site construction work commences.

Even so, planning should not end here and as working drawings and further details become available so it should continue, possibly in the form of stages, or detailed planning .

2.11.2 Reasons for deviating from the plan

It could well be that as a contract proceeds, circumstances change, the amount of work for some items alters and the various priorities differ from the original conception.

Some of the many reasons are listed below:

- The client may change his requirements for some of the work.
- Design for certain sections may change, possible because of the client's requirements or because of a more up-to-date knowledge of ground conditions.
- Weather may interfere with certain sections of construction progress.
- Certain key materials may become difficult to obtain, such as bricks or steel.
- Detailing of certain sections may reveal problems in construction which were not obviously apparent.
- Methods of contract schemes proposed in the contract plan may have hidden snags in practice which restrict output and increase costs.
- Labour problems may be encountered and output may not match expectations.

2.11.3 Establish contract procedure

To cope with all these possible deviations from the plan, it is necessary to have a system whereby the contract can be reviewed and all aspects co-ordinated.

This system will involved the balanced use of all or some of the following techniques.

- Work study
- Control procedure
- Incentives
- Planning in various stages
- Statistical methods

The procedures will vary in detail and application from contract to contract and from company to company, but the principles will remain the same.

2.12 Detailed planning

As a shorter project becomes more complex and involved and the demand for shorter construction periods increase with more specialist firms participating in the work, so the contract plan and programme become insufficient for adequate control to be exercised.

Eventually, a point is reached when, to co-ordinate effectively, it becomes necessary to study the effect of alternative decisions before they are made.

In other words, as more information becomes available and as circumstances change, it will be necessary to examine in greater detail the parts of all of the contract plan and programme.

Any effect on the contract time and cost can be assessed and the possibility of having to make late decisions without sufficient consideration is minimised, also, co-ordination and control become easier.

The title *Detailed Planning* implies taking a closer look at the contract plan to fill in the obvious gaps that planning on a broad scale must contain. As this essentially commences with the receipt of detailed drawings, it does not seem an inappropriate title. This stage is often known by other titles, chief among them being:

2.12.1 Period planning

This is used to emphasise that out of the whole contract programme a specific period is being enlarged for closer examination. Usually the period is from four to six weeks, but this is dependent upon the nature of the work involved.

A very popular form of period planning covers a period of, say four weeks, and as each week's work is completed, an additional week is added at the end, thus maintaining a moving but continuous four-week forward view.

2.12.2 Stage planning

This is used primarily to indicate that only a stage or section of the contract is being enlarged from the contract plan. This could comprise a basement construction, the superstructure of a building, one repetitive floor, the finishing trades or a separate building such as a boiler house.

2.13 Programming (The purpose)

- To record agreed intentions with the client.
- To supply a timetable for co-ordinating the issue of drawings and information, the placing of orders and delivery of materials, and the operations of plant and subcontractors.
- To prepare a basis for the introduction of 'payments by results' or other incentives.
- To show the sequence of operations and the total output rates required of labour and plant.
- To provide a yardstick for progressing and costing.
- To furnish the contractor with the likely financial requirements.
- To discourage changes in design by indicating the natural consequences, whilst at the same facilitating amendments and minimising their harmful effects, should contingencies arise.

Activity 2.1

1. Explain the different types of progress charts and schedules and their uses.
2. Describe how to recording on charts using different methods.
3. Briefly describe the mechanical equipment and plant loading schedules.

Self-Check

I am able to:	Yes	No
• Define the different types of progress charts and schedules		
• Explain the different methods of recording on charts		
• Describe the following loading schedules:		
o Mechanical equipment		
o Plant loading		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 3

Sub-contractors

Learning Outcomes
On the completion of this module the student must be able to:

- Describe how to co-ordinate the work of:
  - Subcontractors
  - Specialists
- Describe the supervision and co-ordination of various trades
- Describe the provision of special facilities such as scaffolding etc
- Describe the allocation of storage space

3.1 Introduction

Sub-contracting is the undertaking of certain work by a contractor whom is a subsidiary to the main contractor. The main contractor engages the sub-contractor to carry out part of the work of the main contract.

In the case of many buildings and other operations, there may be several specialist contractors who concentrate on some particular aspect of the work such as painting, plastering, drainage and water supply or the supply of mechanical equipment such as lifts, air-conditioning or central heating installations.

The employer (building owner) may make separate agreements with each specialist contractor, and this is occasionally done, but it is not the usual practice. It is obviously more advantageous to the owner to have one contractor to look to for the defects, co-ordination, and responsibility generally.

He can also, and frequently does, obtain one of the main advantages of separate contractors by reserving the right of selecting the specialist sub-contractors, and in such cases they are referred to as "nominated sub-contractors", or, if they supply goods, as "nominated suppliers".

Note:
It is, at this stage, important to note that irrespective of whether a sub-contractor is one engaged by the main contractor or nominated by the building owner, or on his behalf, the architect and

	the owner will only recognise the main contractor in all matters concerning the work carried out by such a sub-contractor.

The methods of payment to the main contractor for work let under sub-contract are:

- By bill rates with the work subject to measurement;
- By actual cost plus percentages;
- By lump sum as agreed.

Sub-contracts can be a source of friction, disorganisation and many other problems if not carefully handled. A sub-contractor who, by knocking holes, makes an unnecessary mess of plaster work, or who carelessly knocks bits off door frames, or who will not clear up properly after, is a nuisance to everyone.

On the other hand, sub-contractors often have legitimate grumbles against main contractors who will not supply sufficient scaffolding or knock holes or provide sleeves correctly placed in concrete when it is required of them in terms of the specification.

It is, therefore, most important that all parties know beforehand exactly what they are required to do and by what means. The actual progress of the work will thus flow smoothly, free from unreasonable demands made on one another by the main contractor and his sub-contractors.

The sub-contractor will, with his own foreman, act through the general foreman towards the architect in communication and will, in turn, be subject to control and instruction by the general foreman in the same manner as his trades foreman

It must be borne in mind at all times that a sub-contract is a contractual agreement between the main contractor and the sub-contractor, and that the main contractor will be responsible for all the work carried out by such a sub-contractor, including satisfying himself that the subcontractors turn out the necessary standards of workmanship.

Note:
Regular meetings with sub-contractors for consultation and advice are essential if co-ordination based on co-operation is to be effective.

One quite successful method that the main contractor may use to make this check is to circulate a pro form (**Figure 3.1**) a week before each site meeting. Each sub-contractor may fill in the required information under the appropriate headings and return the form to the main contractor tow or three days before the meeting.

The information from all sub-contractors may then be collated and used as a basis for discussion at site meetings, particularly when asking for details from the architect and consultant or co-ordinating the work or two or more sub-contractors and the main contractor.

SUB-CONTRACTOR'S REPORT SUB-CONTRACTOR: ..... DATE: ..... WORK: .....
DRAWINGS REQUIRED
APPROVALS AWAITED
OTHER INFORMATION REQUIRED
MATERIALS POSITION
LABOUR POSITION SIGNATURE:

Figure 3.1

3.2 Selection of sub-contractors

Sub-contractors, including labour-only and nominated, must be carefully chosen for the following qualities, apart from acceptable price.

- Business integrity and guarantee of service.
- Quality of workmanship which must be equal that required by the specification.
- Ability to meet the programmed completion date(s) must be confirmed, and past experience in this respect is invaluable.
- Financial stability or special payment requirements.
- It is usual for the architect's permission to be obtained before work is sublet on a labour-only basis, and subcontractors must also be approved by the employing authority.
- Details of attendances, facilities, unloading and handling of materials required should be carefully investigated, especially for nominated specialists.
- A proper understanding of the terms and conditions of the sub-contract must be ensured, and the main contract conditions must be made available for inspection if desired.

Those contractors with their own trade departments may allow them to compete at this stage with outside specialists, but confidence between the various members of the construction team is essential.

Sub-contractors must be organised so that their individual start and finish dates dovetail exactly into the overall timetable, and since their efforts in certain classes of building may often account for half the total value of the contract, this liaison is vitally important.

A schedule similar to that suggested in **Figure 3.2**, will be drawn up from the lists prepared, while analysing the bills of quantities, and the appropriate dates taken from the stage programmes.

Although these provisional dates are usually incorporated in the sub-contract orders, it is nevertheless desirable that they should be more positively agreed.

This may be done by formal letter of inquiry, which has to be signed and returned, or, better still, by an early site meeting of all key subcontractors, so that necessary labour strengths may also be discussed and any special attendances or other requirements noted.

The schedule can also be used as a means of progressing the placing of official orders and the eventual call-up of specialists during actual construction.

Note:
Copies or abstracts of all relevant programmes, drawings, schedules, instructions etc must be speedily passed onto the sub-contractors concerned.

SCHEDULE OF SUB-CONTRACTORS AND SUPPLIES

CONTRACT ..... DATE. .....

REMARKS	TRADE/ MATERIAL	SUB-CONTRACTOR SUPPLIER	BILL OF QUANT. REFERENCE	ORDER NO.	ESTIMATED			ACTUAL		CALLED TO SITE
					START	PERIOD	FINISH	START	FINISH	

Figure 3.2

In turn, their labour strengths and progress achievements should be recorded, and any labour, material or information difficulties noted and followed up. An initial site meeting to settle queries and discuss trade sequences and attendance requirements can greatly improve co-operation.

3.3 Personal contacts on the site

sub-contractors can be either nominated or builders' own subcontractor.

3.3.1 The nominated sub-contractor

The nominated sub-contractor is one which has been chosen by the building owner on the architect's advice and he deals mainly with specialised parts of the construction such as electrical, lift and air conditioning installations, mechanical installations etc.

Note:
Although a builder can object to a particular nominated subcontractor this is generally done at the tendering stage of the contract so that on arrival at the site he has been fully approved of by the builder.

Before commencing work the nominated sub-contractor will have signed a sub-contract with the builder and, therefore, must comply with all conditions in respect of the contract the same as those of the builder.

3.3.2 The builder's own sub-contractor

The builder's own sub-contractor is one which has been chosen by the builder himself and does parts of the construction in which the builder does not wish to execute himself such as plastering, painting, glazing, etc.

Although the builder should give the names of all his own subcontractors to the architect for any possible objections once they have been approved there is no direct contact between these sub-contractors and the architect; they are treated in the same way as the builder's own employees.

3.4 Allocation of storage space

Where the contractor's own sub-contractors are concerned the main contractor's responsibility for safeguarding sub-contractors' equipment and material will depend upon the contract.

The contractor will normally be responsible for damage or loss of materials but will not be responsible for the sub-contractors' plant and equipment.

Note:
The responsibility for safeguarding materials and equipment should be clearly defined before the sub-contractor commences his work.

The main contractor should provide space on the site for the subcontractors' hutments and would normally provide space in the materials compound for lock-up accommodation for materials.

Where nominated sub-contractors are concerned the standard form of sub-contract definitely stipulates that the sub-contractors are to provide their own temporary workshops, sheds, etc, and that the main contractor shall set aside a suitable area for these temporary buildings.

3.5 Provision of special facilities

Where the standard form of sub-contractor applies the main contractor is only required to allow the sub-contractors use of scaffolding while it remains erected, or where the contractor has erected none he is required to provide enough scaffolding for the sub-contractor to erect and afterwards dismantle himself.

Note:
The main contractor would provide free supply of water for the use of the sub-contractors.

Despite these obligatory provisions, which are particularly applicable to nominated sub-contractors, it is in the contractor's interests and especially when own sub-contractors are concerned to provide all reasonable other facilities to avoid irritating hold-ups.

3.6 Co-ordinating the work of sub-contractors

The success of a building project depends upon the efficient coordination and control of sub-contractors more that it does on any other factor. This can be appreciated when one realises that sub-contractors account for a larger percentage of the financial turnover of the building industry than do main contractors.

Did you know?
On many sites it is not unusual to find that three out of every four men are employed by sub-contractors.

To get sub-contractors to work within the general framework of the overall site programme can be very difficult in many cases.

Major firms are usually sufficiently concerned about their reputation for good service to spare no effort to fulfil the requirements of the main contractors.

There are, unfortunately, many medium and small-sized firms of sub-contractors who are ready to agree to any condition and to make all sorts of promises in order to get the job, and it is the site manager who suffers the consequences when he tries to get them to keep their promises.

When preparing the contract programme the site supervisor should arrange meetings as necessary with the sub-contractors and get their co-operation and agreement on the programme; this would help to co-ordinate the whole works.

In the case of nominated sub-contractors it would be an advantage if the architect could be present at the meeting with them as this would aid collaboration.

Before these meetings a questionnaire will be circulated to let those involved know the points to be discussed and allow them to formulate their answers.

Examples of questions:
- How much notice do you require before commencement?
- What will your labour force be?
- What is the minimum amount of work you wish to do at one time?
- What information do you require before starting?
- When will information be available on your requirements (for leaving out holes, building in special conduit blocks, etc.)
- What are your requirements for storage?
- What attendances do you require?

When agreement has been reached on these points the subcontractor has no excuse later on for not adhering to the contract programme through being unaware of the time required for his work, etc.

In some cases, of course, when the specialist firms have not been nominated at the planning stage, it is necessary to decide on a duration time.

This, however, should be based on the quantity of work involved, and this period of time should be communicated to the firm immediately it is nominated. If the sub-contractor then cannot agree to the time given him, the main contractor has a right to object to the nomination and request the Architect to use another firm.

Note:
When sending out for quotes for specialist work after the project has started, the durations in the programme should be specified, with the latest starting and finishing dates emphasised.

Once this preliminary work is completed it is mainly the site manager's job to take over co-ordination and control of subcontractors, and this is very often an unenviable task. The site supervisor should begin to establish control in about two weeks before the specialist firms are programmed to commence on site.

At this point he should request a representative of the subcontractor to attend the weekly site management meeting to be held the week berfore the sub-let work is to start.

During this meeting the sub-contractor's representative should be fully informed of the circumstances prevailing on the job. He should be asked to satisfy himself

and agree that all preparatory work is, or is about to be, completed to allow his work to start.

He should check storage facilities for materials and welfare arrangements for his men. He should then arrange for the proposed foreman to visit the site a day or two before he and his men are due to start.

3.7 Supervision and co-ordination of various trades

Once sub-contractors have commenced work on site the job co-ordinating the various trades within the overall site programme begins.

Note:
A point to remember here is that all sub-contractors, whether directly employed by the main contractor or nominated by the architect, are subject to the directions of the main contractor's agent, viz. , the site supervisor.

There are a few firms of specialists who feel, because they are regularly nominated by certain architects, that they are a law unto themselves when on site and tend to imagine that the site manager has nothing to do with them.

This misconception must be corrected early on with the help of the architect, if necessary.

The best way to bring about co-ordination between all trades is to hold a weekly site management meeting. All trades foremen or charge hands working on the job should be required to attend these meetings.

A weekly site programme for the following week is produced at each of these meetings and all queries and disagreements resolved before the work actually starts. Trade by trade these are various points to be considered by the site supervisor in the course of a project.

3.7.1 Piling

The piling contractor will normally require that the site be reduced and levelled to formation level - top of pile caps. If there are any large holes these should be brought to formation level by back filling. Obstructions, such as old brick footings or concrete foundations, must be removed where piles are to be bored or driven.

The centre of each pile must be set out by driving a 13 mm mild steel rod into the ground. The rod is driven until it is about 75 mm below formation level and covered with a few pieces of hardcore, which the piling contractor's men will remove.

Note:
Unless the ground is firm and the piling operation takes place during dry weather, access roads made up with sleepers or hardcore will have to be provided.

3.7.2 Drainage

Drainage must be well under way before the ground-floor slab is cast. If this operation is not efficiently organised the superstructure may be held up.

The preparatory work, which must be completed before the plumbers start, is complicated and requires careful setting out. The excavation of trenches for pipe runs should be programmed to start about one week before plumbing commences, in order to ensure continuity.

If a connection is to be made into an existing manhole or main drain, then its invert level should be established. Pegs should be driven to the edge of each manhole position and their height in relation to invert level or main drainage connection marked.

The main drainage connection is made by the local authority or council and is one of the preparatory items to be completed before plumbing starts. Sight rails and boning rods are used in the routine way to establish the correct gradient when casting the concrete bases for the drains.

If possible, drainage should start at the main connection, and this operation too, is one of the preparatory jobs to be done.

3.7.3 Mechanical and engineering services

Before floor slabs are cast and walls built, the site supervisor should hold a meeting with the foremen dealing with electrical, plumbing, air conditioning, sprinkler and lift installation.

The positions of pipe runs and ducts for these services should be established, and provision made to allow for such runs when building floors and walls. If a vertical duct is required by any of these trades, then it may be possible for other trades to use it as well.

Note:
Where pipes pass through walls, it will be necessary to allow for metal, plastic or asbestos sleeves to be fixed in the wall as it is being built.

3.7.4 Electrical

The electricians will require conduit runs cut in the face of walls and in the floor.

3.7.5 Plumbing

The plumbers will have water pipes running vertically and horizontally. These are normally surface fixed and boxed in.

A central duct is usually designed for vertical soil pipes in multi-block buildings, and this may also be used for other services.

3.7.6 Miscellaneous

Provision must also be made for the following services:

- Air conditioning
- Lift installation
- Roof finishes
- Plastering
- Tiling
- Painting

3.7.7 Defects

In order to achieve the programmed date of practical completion, attention must be given to defects and their rectification long before hand over. Many general foremen receive a lengthy snagging sheet instead of the practical completion certificate, because, having completed all the work on the drawings, they feel the architect will accept handover without looking too closely at the job.

Note:
The architect is paid by the client, and unless workmanship is up to specification, will not accept a job on his behalf.

About two months before handover, the site supervisor should make his own inspection, and issue defects lists to his own men and to sub-contractors. When these defects are remedied, he should make another tour with the architect or the clerk of works about two weeks before the contract is to be handed over.

By tackling things in this way, the job is more likely to be accepted by the architect.

Each sub-contractor should be given a list of the defects he is considered responsible for. He should also be informed of the date by which the work is to be completed, and warned that if this is not adhered to the main contractor will execute the work and contra-charge the sub-contractor.

Activity 3.1

1. Describe the process used when co-ordinating the work of subcontractors.
2. Describe the process used when co-ordinating the work of specialists.

	**Self-Check**		
I am able to:		**Yes**	**No**
• Describe how to co-ordinate the work of:			
o Subcontractors			
o Specialists			
• Describe the supervision and co-ordination of various trades			
• Describe the provision of special facilities such as scaffolding etc			
• Describe the allocation of storage space			
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.			

Module 4

Materials

Learning Outcomes
On the completion of this module the student must be able to:

- Describe the various methods of:
  - Ordering
  - Storage
  - Control
  - Issue
  - Crediting of materials

4.1 Introduction

Materials form a major proportion of the expense of most building contracts and unless controlled may involve a contractor in considerable loss, arising out of wastage and pilferage. Control of material is essential at all stages, ie ordering, receiving, storing, issuing to sites, and transferring from one site to another.

4.2 Ordering materials

Materials should be purchased and obtained:

- in good time
- in correct quantities
- at the most economical rates

To supply sites with materials the majority of builders maintain some form of stores depot for small quantities of common user stock, to be issued to contracts as required, but generally arrangements are made with the suppliers to deliver materials direct to sites on dates specified by the builders.

Note:
The purchasing and ordering of building materials and components are not normally the responsibility of the site supervisor except on very small jobs.

For the vast majority of contracts and developments the ordering of materials is the function of an individual or group at the headquarters of the builder.

This individual or head of the group is usually known as the buyer, who may have an assistant or assistants, depending on the size of the firm.

The buyer will obviously have considerable experience and will have personal contacts in a large number of material supply firms and manufacturers, and have a wide knowledge of day to day material prices.

Despite the site supervisor's non-involvement in purchasing and some of the other aspects of material control and documentation, this lecture describes the whole process of a materials supply procedure which is used with variations by the majority of building firms.

4.2.1 Supply procedure

A materials supply procedure is diagrammatically shown in **Figure 4.1**, which depicts the relationship of the persons and departments within the overall process.

4.2.2 Purchase order

The formal order to the supplier should be the firm's official printed purchase order from a numbered pad or book.

The purchase should be in triplicate:

- one copy to supplier
- one copy to either yard storeman or site
- one copy to the accounts department for checking invoices

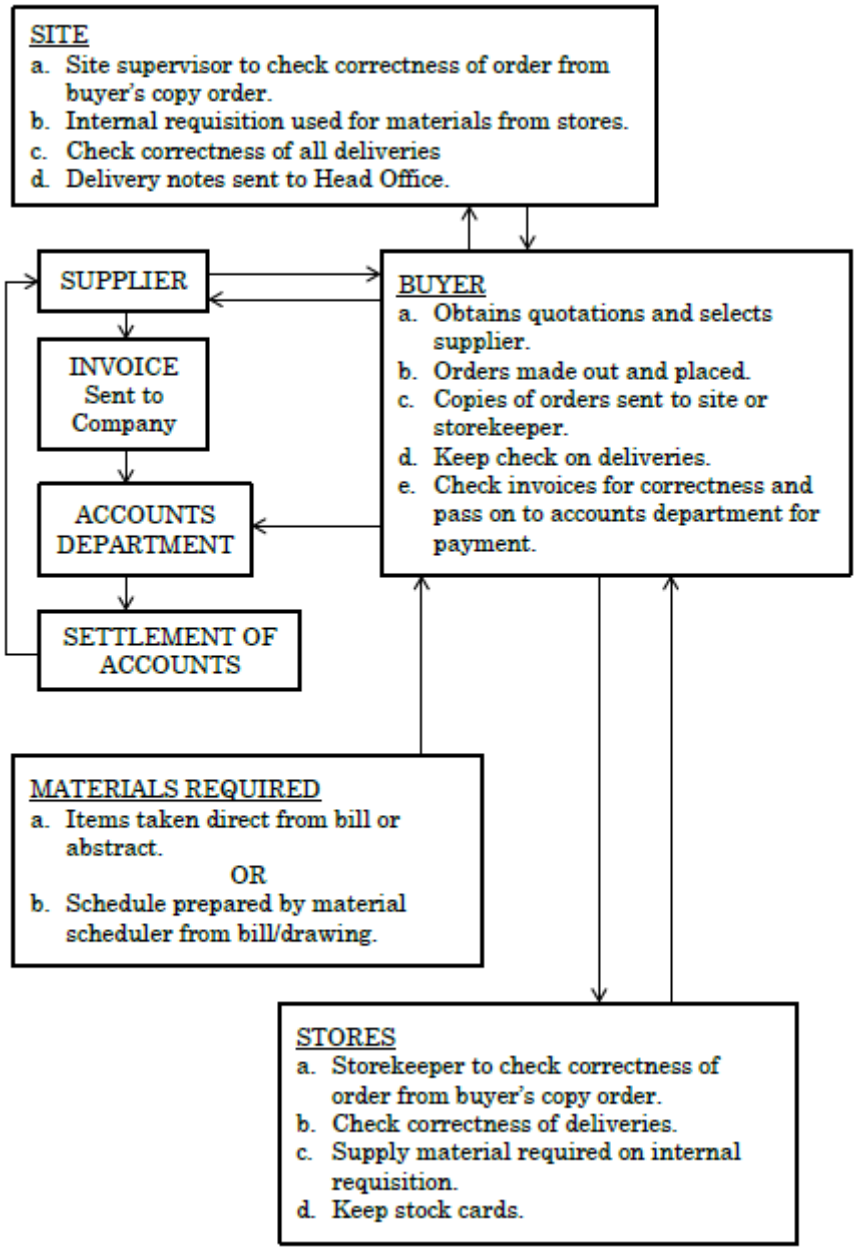

Figure 4.1

The copy of the purchase order held on site or in head office stores would enable site or storekeeper to be aware of the promised delivery dates and to make arrangements for their receipt and storage.

Strict control over the supply and delivery of materials in the case of the small firms may be maintained by filling a copy of the duplicate order under delivery dates and checking against the deliveries made.

The purchasing department of a medium to large firm may maintain for each supplier a supplier's record card on which would be recorded information from

the copy purchase order. Spaces should be left for recording remarks such as the date of reminders to suppliers in respect of overdue delivery, etc.

The suppliers record cards should be filled in month and date order of delivery so that each day the purchasing department can inspect the cards for the current day and ensure that the suppliers deliver the materials as promised.

Note:
Outstanding deliveries should be known immediately and the matter could be taken up with the supplier concerned.

The date of the reminder would be forced on the suppliers record card and until the supply is received the card would be filed in a separate section of the file.

4.3 Supplier's documentation

4.3.1 Advice note

This is sent by supplier or manufacturer to the site, stating date, method of transport and the description of goods despatched. This will give the precise date of delivery and will enable site supervisory staff to make adequate preparation for off loading and storage area.

Note:
An advice note is not sent in respect of all materials and its use is being confined generally to the more expensive and specialised type of materials and goods.

4.3.2 Delivery note

This is the document that must be signed by the foreman or the checker when the goods as stated on the note have been unloaded and after he is satisfied with their condition. Careful check must be made to ensure that goods are not only there but are also in good order and not damaged.

Often goods arrive in packing cases or crates and it is not possible to examine the contents; if this happens, upon signing the delivery note the foreman or checker should also write across it "not examined".

Two delivery notes will be supplied by the transport driver; one for himself as a check to his employer that he has made the delivery satisfactorily and one for site reference. If goods are missing or damaged this should be clearly noted on both copies of the delivery note in ink, signed also by the driver.

Note:
If goods are returned for any reason with the delivery truck, the driver should be asked to sign the correction on both copies of the delivery note.

Where, in rare cases, such as in some instances when delivery is made by rail or post, no delivery note accompanies the goods then the checker should immediately "make" a note or slip which will serve as the record of all materials delivered to the site.

4.4 Receipt of materials on site

4.4.1 Materials delivery sheets, materials record book

This is a complete record of all materials received on site and must be filled in with the details from the delivery notes. A copy of this record, supported by copies of delivery notes from suppliers should be forwarded to head office, usually weekly, so that records may be maintained up to date.

This book is filled in daily from information taken from the delivery notes. The prices and amounts are filled in against each item at Head Office. A running total cost of materials for a project is easily and quickly obtained.

The copy purchase order held on site should be "marked-off" with the delivery date and details of part deliveries (if any). On completion of delivery of each order the copy purchase order should be forwarded to head office for checking against records.

4.4.2 Materials delivery board

Often used on site to show clearly when deliveries are due, generally bulk phased deliveries, which often is simply a ruled blackboard on which is chalked amount and date of delivery.

4.4.3 Requisition

This is a document used by the site to obtain sundry items from central or head office stores on a day to day basis. Two copies would be made out of each request for material – top copy to store, duplicate retained.

4.5 Transfer of materials and stores

Transfers of materials and stores between sites and central of head office stores may take place for reasons such as set out below:

- Materials and stores urgently required on another site.
- Materials and stores surplus to requirements transferred to another site, either during or at the termination of the contract.
- Materials and stores returned to stores during or on the termination of the contract.

The material transfer form should be signed by the site clerk and the four copies distributed as follows:

- Original – to head office accounts department
- Copy – to transfer site clerk or head office storekeeper
- Copy – signed and returned as a receipt to the site clerk of the transferring site

- Copy – retained by site clerk on transferring site

The head office accounts department will enter the unit rates and values in the spaces provided on the form.

Its correct use ensures that charges for materials can be made to the receiving project and deducted from the site supplying the goods. In the accounts, the site giving will be credited, the site receiving will be debited.

4.5.1 Invoices

These are very similar to delivery notes, in as much as they state the same information; the only difference being that the price of the goods is now clearly shown for payment.

This document is sent to the head office where it is checked against the delivery note which has been sent from the site. If they agree, payment will be made.

4.5.2 Waste materials

A big problem on most building sites is the large amount of material that, due to varying circumstances, become classed as waste. Basically this is a problem of the site supervisory staff to control and wherever possible, eliminate; it requires a supervisor to be constantly on the lookout for loss.

Little success is achieved if the operatives do not play their part, and so the importance and value of all materials should be constantly impressed upon them.

A number of firms adopt a visual approach to this by placing (upon a large signboard on site) various items of material, such as brick, tie iron, roofing tile, or length of timber, etc, stating alongside each its costs, and so drawing attention to the fact that even very small items do cost money.

In most cases, it is not the los of valuable items that gives rise to concern, simply because these items are generally very carefully stores, checked and issued when required. It is the every day items of material which is the biggest concern.

Note:
Generally, because each small separate item costs very little, sight is lost of the fact that if a large number are wasted, the cost can be a very big thing.

Take, for example the brick, in itself of not much significance, but add together the number that are broken in handling, lost through bad storage, thrown under lorries that get stuck, buried under aggregate piles, and those lost through the cutting of half-bricks, and this adds up to a high percentage of the total and constitutes a loss of money. This applies to many such materials.

How, then, can waste be reduced? By applying the following:

- Ensure that materials are delivered as required so that site storage time is cut to a minimum. This requires careful phasing of deliveries between site and supplier.
- Ensure that materials delivered are those specified for that particular job.
- The issuing of just the right amount of material with only a reasonable allowance for wastage to workmen.
- Ensure that workmen are not producing excessive amounts of "offcuts".
- Allocate and prepare storage areas. This can be done by marking on the site plan the exact layout of all material storage areas. Drivers delivering materials can then be directed by the checker where to place their load. Make sure lorries can get to the area with as little interruption to normal work as possible, and that sufficient space is allocated so that other materials or work is not damaged in the process of unloading.
  Always try to ensure that materials are re-handled as little as possible and that they are placed as close to the final position in the structure as room allows.
- Make sure that when materials are stored, they do not deteriorate.
- Collect waste, eg half bricks, and use to prevent more cutting - a few at each bricklayer's spot will suffice.

4.6 Material control

The prime function here is to ensure that materials are ordered in good time, and that a very close watch is kept upon planned delivery dates. Schedules are required here so that quick reference can be made as to when and from whom deliveries are required.

Note:
Material in short supply or late delivery should be chased up immediately, with possible alternative materials or suppliers being sought.

Control on site must be exercised in respect of waste, deterioration, pilfering and misuse. Careful checks should be made to ensure correctness of orders and that materials delivered can be properly stored and unnecessary handling avoided.

Note:
Standard quality of materials should be maintained through checking against samples or specifications.

4.7 Security

4.7.1 Materials

Many items of building material are stolen each year by outside persons and this reflects in general overall site security.

Also, much material and small hand tools are lost to the builder each year through pilfering by the operatives; this is easier to control than outside theft, by adopting the following procedures:

- Items that are small, eg door furniture, should be issued by storemen, foremen, or the like, and a record kept.
- Accurate stock control must be maintained with regular checks.
- Compounds and storage sheds should be kept locked after issue of material.
- Cars, wherever possible, should be allocated space away from the construction so that "loot" cannot quickly be hidden in car boots.
- Site supervisors must set an example by practising what is preached.
- Inspection of delivery lorries leaving the site.

4.7.2 Site security

Site security can cause many problems and it becomes very difficult to lay down hard and fast rules and precautions that can be followed, because of the considerable difference in sites, types of building and the firm's efficiency in these matters.

The problem is also not just one of keeping the professional criminal out but also the vandal, old and young alike, and, of course, the onlookers and curious visitors who trespass upon the site and often cause much damage due to ignorance.

It is clear, therefore, that security has to guard against two separate problems:

- Theft, especially of high value materials, such as copper and lead, that not only result in loss of money but may also cause delay in construction.
- Damage due to unauthorised persons being on site, whether wilful or accidental.

One of the most common forms of defence used on site is that of constructing a hoarding around its perimeter. This generally is sufficient to stop the curious sightseer, but for the criminal the hoarding presents little deterrent as it is usually easy to scale and, of course, once the unwelcome visitor is inside, he will work undetected, as he cannot be seen through the protecting hoarding.

It would seem, therefore, that some form of open hoarding is better, such as a chain link fence; and with the addition of a few strands of barbed wire at the top, reasonable protection should result, for, although easy access may be obtained by cutting a way in, this is noticeable, and a movement in a locked-up site is easily spotted.

Note:
Openings in either type of hoarding should be adequately locked and secured to ensure that criminals cannot drive in transport.

Inside the site, all movable items and small pieces of plant, equipment, and materials should be locked away and, of course, with careful ordering, stock will

only need to be kept to a minimum, which in itself is a deterrent to a would-be thief as he may consider the site not worth breaking into when rewards are small.

A practice that is also growing is that of maintaining floodlighting on the site during the hours of darkness: this again helps deter the criminal as he can easily be spotted.

The use of night-watchmen is open to criticism due to the fact that most of those engaged in this work are old and would prove of little value in the apprehension of a criminal; but they are useful in as much as they may disturb him, and should then have means of raising the alarm.

Did you know?
A decrease in the use of night has watchman taken place with the introduction of guard dogs similar to those on military installations.

Keys often result in a breakdown of security due to loss, or inadequate control of who has them, or access to where they are kept. A close check should be kept on keys and only persons requiring them should have them allocated.

As already stated, the problems on site security are many and varied but it must be remembered that often the police will be able to offer invaluable advice, especially if the site is situated in a heavy crime density area, It is also good practice to ask the police to keep an eye on the site, and also either leave with them a set of keys or a local address where keys can be obtained in case they require access as a result of theft or fire.

Activity 4.1

1. Describe the various methods used for the ordering of materials.
2. Describe the various methods used for the storage and control of materials.
3. Explain the methods used to issue materials.
4. Describe what methods are used for the crediting of materials.

Self-Check

I am able to:	Yes	No
• Describe the various methods of:		
o Ordering		
o Storage		
o Control		
o Issue		
• Crediting of materials		

If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.

Module 5

Handing over Completed Work

Learning Outcomes
On the completion of this module the student must be able to:

- Explain the following:
  - Defects liability
  - Cleaning
  - Security arrangements
  - Removal of:
    - plant
    - surplus materials
    - debris
    - huts
    - sheds
    - offices
    - equipment

5.1 Introduction

When work is complete, it is handed over and a final certificate of completion is issued. The Engineer must ensure that the inspection is carried out precisely or it may be considered an act of negligence on his part.

5.2 Miscellaneous points to watch

Where a penalty clause exists, the resident engineer must remind the engineer to take this into account in the production of the final certificate.

Warning note:
An issue of a final certificate without reference to any penalties written into the contract might be taken as an act of negligence by the engineer if he should have deducted penalty money from the certificate, but did not.

The resident engineer should not accept lower-grade materials or workmanship at prices lower than the prices tendered in the bill of quantities unless the engineer agrees that the inferior material or work is still satisfactory for the purpose of the structure.

Note:
It is the duty of the engineer to present a completed contract to the employer - not an incomplete or unsatisfactorily executed contract however much the price may have been adjusted.

The resident engineer should, whenever an alteration is proposed by the contractor, automatically reply "How much more is it going to cost?" This question will prevent misunderstanding arising later about whether or not the contractor was expecting extra payment for the alteration.

He must give prompt notice to the contractor on defects arising, otherwise the contractor is entitled to assume that the work is satisfactory.

If part of the works is taken over by the employer before a completion certificate is given, the resident engineer must be watchful of the work taken over so that he is in a position to advise the engineer as to what subsequent deterioration in the condition of the work is due to its premature use, and what due to inherent defects in it, The contractor is not responsible for deterioration due to wear and tear.

Where a problem in the construction calls for the exercise of special skill which the engineer himself possesses or which specialist engineers possess who have already been employed in the design stages of the work in addition to the engineer, the resident engineer should not exercise his own judgement, but should refer the matter to the engineer.

There will, of course, be times when troubles arise. When bad workmanship comes to light, or when wholly unsuitable methods are being used, it is the resident engineer's duty to have the work rectified or the unsuitable methods stopped. This is easy to say, but not so easy to carry out in practice.

Suppose, for example, it comes to the resident engineer's notice that a partly built wall is being built: to a very inferior standard – the bricks are chipped, the joints are irregular and the face is not uniformly plane.

Now the first essential in such matters is that the bad workmanship ought to be discovered at an early stage.

It is no use letting it be carried on; nor is it of use to discover the defects when the structure is complete, or nearly complete, or all the troubles and difficulties of trying to get things right will be magnified.

The second essential is common sense: to keep one's temper, to refrain from accusing the contractor of fraud or incompetence, or from saying to the workman, "That has got to come down, for a start."

Any one of these methods can be guaranteed to cause ill-feeling, which is not in the least helpful to anyone.

Instead, the resident engineer ought to ask the agent to come and look at the wall with him, indicating that he is unhappy about it. When they meet at the wall, the wise resident engineer will say nothing, but will allow the agent to examine the wall for himself.

One of two things will now happen - either the agent will make some admission of fault or he will say, "What's wrong with it, then? If the agent is ready to admit some fault, there is no doubt that, with careful handling, all will be made well.

If, on the other hand, the agent asks what is wrong, the resident engineer must tell him clearly, saying not only what is wrong, but what would be right in the circumstances - confining his remarks to the work itself.

A discussion will then have to take place as to the possible remedies to be adopted and, in discussing remedies, the resident engineer will have to be flexible.

Note:
His main aim must be to get the matter right, but he must be prepared at the same time to accept any reasonable alternative for achieving his purpose.

For instance, instead of pulling the wall down and rebuilding it, the agent might offer instead to plaster the wall at his own expense, to a presentable appearance.

If, however, no solution appears possible which the agent will accept, it is best to leave the matter in abeyance for the time being, either for another discussion after both parties have had more time to think about the problem or for reference to the engineer for his decision.

There will be occasions when the resident engineer will not be at all sure that he should do. Even the opinions of experts may differ, and it may sometimes be very difficult for the resident engineer to decide whether or not he should accept some method proposed by the contractor's agent.

The agent has to think of ways and means of doing things that are easiest and cheapest for him. Naturally, he is quite likely to propose methods which come

as a surprise to the resident engineer, who has been schooled to think in terms of using the "right" machines and "right" methods for each particular job.

He will, therefore, be in considerable doubt as to whether some novel method, or some short cut, proposed by the agent, will bring about the result required, or whether it will result in some eventual harm to the quality or durability of the permanent works.

The reasonable resident engineer will not wish to deprive the agent of opportunities of benefiting from his own skill; on the other hand, he must not allow chances to be taken which might eventuate in damage to the works.

Note:
It is the quality of the work which is the resident engineer's main duty to safeguard.

If, therefore, he permits the agent scope to proceed on his proposed method, he would be quite within his rights to forewarn the agent that if any harm does result, then the contractor must make his mistake good at his own expense.

In coming to his decision, and in the event of his not being able to discuss the matter in time with the engineer, he will be 1dse if he discusses the problem with his own inspectors and engineering staff, for on these difficult matters it is al~1ays usual and encouraging to have a consensus of opinion on one's side.

5.3 Handing over

Handing over comes into operation when the building or project is completed, and ready for occupation. The following clauses are usually found in a bill of quantities and must be adhered to.

It is more fully described in a specification.

1. Notice boards - on completion of the contract, the notice boards and supports are to be removed from the site and any work disturbed made good at the contractor's expense.

2. Offices and sheds - on completion, the whole to be removed from the site at the contractor's expense.

3. Unless otherwise excavated material described or ordered, all surplus excavated material is to be removed from the site at the contractor's expense.

4. Maintenance and clearance of site on completion – the contractor shall maintain the site at all times in an orderly tidy, workman-like condition, to the to the satisfaction of the architect.

On the completion of the works, the contractor shall clear away and remove from the site all constructional plant, surplus materials, rubbish and temporary works of every kind, and he shall restore the ground, access roads, fences or any structure that may have been interfered with by him or his employees, and he shall leave the whole of the site and the works clean and in a workman-like condition to the satisfaction of the architect.

Note:
The contractor shall also satisfy the architect that he has complied with the negotiated conditions in which the site must be left.

5. Certificate of completion of works. As soon as, in the opinion of the architect, the works shall have been completed for all practical purposes and shall have satisfactorily passed any final test that any be prescribed by the contract, the architect shall on receiving a written undertaking by the contractor to finish any outstanding work within such reasonable time during the period of maintenance as the architect shall specify, issue a certificate of completion in respect of the works and the period of maintenance of the works shall commence from the date of such certificate.

   Provided that the architect may give such a certificate with respect to any part of the works before the completion of the whole of the works and shall upon the written application of the contractor give such certificate with respect to any substantial part of the works which has been completed to the satisfaction of the architect and occupied or used by the owner subject to the provisions of the following.

   Should the owner wish to take over any portion and before completion of the whole works, the owner shall have the power to do so provided that at no time the normal progress is impeded or otherwise by agreement between the contractor and the architect thereof; and when such certificate is given in respect of a part of a works, such part shall be considered as completed and the period of maintenance of such part shall commence from the date of such certificate.

6. Period of maintenance shall mean the period of maintenance named in the tender, calculated from the date of completion of the works certified by the architect.

   In the event of the contractor being required to rectify or being engaged in rectifying defects in the work prior to or at the date when the period of maintenance is due to expire, the architect will have the right to extend the period of maintenance in respect of the portion of works being or to be rectified until the work of rectification is complete, and the expression "period of maintenance" shall be held to include any such extension.

5.4 Defects

In building contracts there is usually a clause inserted in connection with defects. In the schedule of conditions of Building Contracts, clause 13 refers: ***Practical completion and defects liability***.

	**Definitions for the purpose of this clause:**

a. The "***completion list***" shall mean the written list detailing the work remaining to be done on those parts of the works handed over to the Employer by the Contractor.
b. The "***preliminary completion list***" shall mean the written list in which is specified all such work as is required to be done by the Contractor in order to entitle him to receive a certificate of practical completion.
c. The "***defects list***" shall mean the written list of patent defects in which the Architect has specified any defects identified by him at the end of the patent defects liability period.
d. The "***patent defects liability period***" shall mean the period beginning on the date of practical completion of the Works, or the relevant parts thereof, and terminating three months from that date.

5.4.1 Practical completion

When, in the opinion of the Architect, the Works, or any parts thereof which the Contractor has agreed to hand over earlier to the Employer in accordance with the provisions of the schedule to these terms, are reasonable complete, the Contractor shall hand over to the Employer the Works, or such completed parts, as the case may be, provided that the practical completion certificate for the Works as a whole shall not be issued prior to the date specified in the schedule to these terms unless by agreement between the parties.

The Architect in each such case shall issue forthwith to the Employer and to the Contractor a certificate of practical completion and, for those parts handed over, a completion list. The Contractor shall not, in respect of those parts handed over, be obliged to execute work other than that specified in the completion list.

Work remaining to be done at the date of practical completion shall be subject to later inspection by the Architect within fourteen days of written notification by the Contractor that such work has been completed. The period during which the Contractor is liable for defects in such work shall commence on the date of approval by the Architect.

Should the Architect fail to issue a certificate of practical completion and the completion list, he shall, within fourteen days of receiving written demand from the Contractor, issue to the Contractor the preliminary completion list.

5.4.2 Defects liability

Any defects in the workmanship and materials and any damage caused to the Works thereby, which may appear within the patent defects liability period, due to materials or workmanship not being in accordance with this agreement shall be made good by the contractor at his own cost.

5.4.3 Certificate of completion

When, in the opinion of the Architect, the work specified in the defects list has been completed, he shall issue a certificate of completion of the Works. The completion of making good defects shall be deemed for all purposes of this contract to have taken place on the day named in such certificate.

5.5 Leave in perfect condition

- All superfluous earth rubbish, debris, etc. that may be accumulated during the progress of the works is to be cleaned and carted away from time to time.
- Clean all glass, twice wash floor and paving, and leave the whole of the premises in a thoroughly clean and perfect state, fit for occupation at the completion of the contract.
- Care must be taken not to use any cleaning materials which are likely to cause damage to the finished surfaces.
- The clearing of' the bush, trees, rubbish, etc. being described in the excavator's bill where the extent of such clearance will be given approximately in metres, large trees and grubbing up roots being numbered. Excavation to reduce levels and cart away or deposit on site as required being measured in m^3.
- In the specification under a heading of general conditions of contract, a clause will be found relating to plant and materials. It reads as follows:

  "Such material, plant or machinery shall not be removed from the site of the works without the previous consent of the architect/engineer. When works are finally completed, plant, machinery and material which remain unused shall forthwith be removed from the site of the works."

5. 6 Security arrangements

The contractor is to allow for storage and watching of such materials sent on the site by employers, and will be held responsible for their safety, and shall indemnify the employers against any loss or damage that may occur.

The contractor is to allow for all watching of the works as directed by the architects or demanded by the authorities and for warning lighting to all parts of the works which constitute a danger to the public. Attention is also drawn to the provision of hoardings for enclosing the site and protection of the public.

Protection from the storms, etc, cover up and protect at all times throughout performance of the contract, all work liable to suffer damage.

Note:
A guarantee in the form of a banker's guarantee of 10% of contract amount and insurance are further stipulations normally made in the bill.

The builder, like any other citizen, has risks against which he is compelled by law to insure; he also has other risks against which most contractors normally cover themselves.

The extent to which the builder insures depends upon the type and magnitude of the works upon which he is normally engaged.

Activity 5.1

1. Explain defects liability.
2. Explain good cleaning practices.
3. Explain correct security arrangements for a building site.
4. Explain how to remove plant and surplus materials.
5. Explain how to remove debris, huts, sheds, offices from the site.
6. Explain the removal of equipment from the site.

Self-Check

I am able to:	**Yes**	**No**
• Explain the following:		
o Defects liability		
o Cleaning		
o Security arrangements		
o Removal of:		
– plant		
– surplus materials		
– debris		
– huts		
– sheds		
– offices		
– equipment		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 6

Administration and Personnel

Learning Outcomes
On the completion of this module the student must be able to:

- Describe the principles of administration
- Describe the effects of efficient site administration upon the following:
  - Production
  - Formulating site policy
  - Procedure
- Explain allotment duties
- Describe the delegation of responsibilities
- Describe personal contacts on the site regarding:
  - Employer
  - Architect
  - Consultants
  - Building owner
  - Local authority officials etc
- Describe the qualifications and personal characteristics required in:
  - Foremen
  - Supervisors

6.1 Introduction

Administration can be said to be that aspect of business whereby ideas and policies laid down by the management are interpreted by supervisors and translated into instructions for action, and further, that the progress of activities is regulated and checked against plans.

The six principles of administration, namely to:
- forecast
- plan
- organise
- command

- co-ordinate
- control

as defined by early pioneers in management studies with the addition of a further principle of 'to communicate' have, of recent years, been considered as being the processes or principles of management.

6.2 Administration or management processes

Management is the art and practice of organising and co-ordinating business affairs in an efficient manner, a d the processes are those activities which managers at all levels must carry out if they are to be successful.

There are recognised to be seven major processes of management, sub-divided and related as follows:

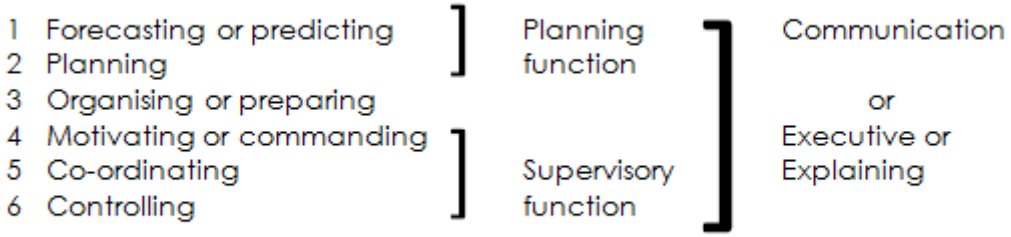

Figure 6.1

Six of the processes are divided into planning and executive or supervisory functions and around and through these a further process runs - communicating or explaining - which is the life blood of management.

6.2.1 Forecasting

For forecasting to be fully effective it must be based on fact and not merely on intuition, therefore a necessary preliminary to forecasting is investigation, ie finding out all the facts.

At management level forecasting is necessary to formulate a policy for the firm and a good policy is based on the following facts, such as :

- What proposed type of building projects are there over the next ten years? eg houses, flats, factories, etc
- Is building land available?

… and so on.

Once all these aspects have been investigated then the firm can forecast what will be required and so develop an organisation best suited to take advantage of future possibilities.

6.2.2 Planning

This stage arises from sound investigation, making a constructive forecast and then setting a clear objective.

	**Note:** In everything we do, whether in business or personal life, the first step to proper success is the making of a good plan; the amount of detail will depend on the complexity of the task in hand.

Planning is a thought process. For a plan to be good it must have certain basic characteristics which are:

- that it must aim towards an objective;
- must be realistic and possible of achievement;
- thereby providing for easy control.

6.2.3 Organising or preparing

This is providing everything necessary to the carrying out of a plan, ie materials, plant and equipment, labour, money, etc.

It is the stage between planning and action, but is complementary to planning, because a plan must take into account all the resources available.

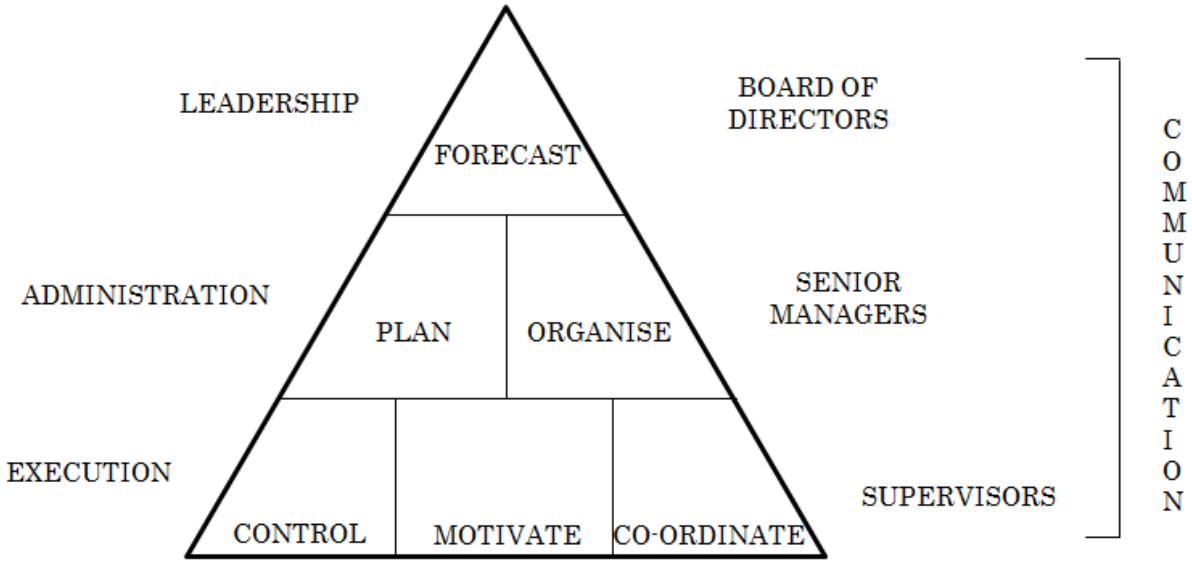

Figure 6.2

6.2.4 Motivating

It is to obtain the willing co-operation of those carrying out the work and, more simply defined, it's whatever makes people move. Without motivation the operation would not be effective and plans, standards and targets would not be achieved.

Motivation is encouraged by good planning, organising and coordination. Good leadership is essential to good motivation and it should be borne in mind

that the tone of an undertaking is largely a reflection of the personality and outlook of it's leader; an organisation, whether it be the whole firm or an individual site, cannot fundamentally be better than its chief supervisor.

6.2.5 Co-ordinating

It is providing unification of all the operations and effort by blending together all the people involved and the activities they perform to achieve maximum efficiency and harmony.

Co-ordination can be made effective by:

- Arranging regular meetings to discuss matters and assist in ascertaining that everyone is pulling the same way and with one common aim as a team.
- By arranging for early contact of all people concerned to put them fully in the picture and investing their co-operation.
- Providing programmes, instructions, etc. having first discussed these with the people concerned.
- Keeping people fully informed of the current situation.
- Maintaining high morale amongst members of the organisation.
- It is essential in co-ordination that proper chains of command are used.

6.2.6 Controlling

This is the obverse of planning, for it is practically useless having prepared a plan to expect it to be carried out to completion without further effort, for without control any plan loses its effectiveness.

Controlling, then consists of checking to see that what should have been achieved, has been achieved and is concerned with continually measuring the results achieved against those planned and, where necessary, to be able to take remedial action to put matters right.

Definition: Controlling
The setting up of procedure so that comparison is regularly made between the plan and actual performance.

Supervision and spot checks do help to keep everyone alert, but true control is through where, at regular pre-determined intervals, a comparative statement of work done against work planned is produced; this can be in the form of progress reports, progress charts etc.

Note:
For control, to be effective, it should be continuous, and also provides a basis for future planning.

6.2.7 Communicating

This is the one major process of management which runs through all the other stages but is a special aspect of co-ordination.

It consists of making people understand what you want. The ability to convey messages clearly, vividly and convincingly by speech, or writing is the necessary key for the exercise of authority, and is essential in a good leader.

The spoken word is more dynamic and infectious and, more particularly, useful for short term persuasion, while the written word - being more permanent, is more effective and suitable for long term directions.

Note:
Information passed on should be clear, precise and unambiguous.

Communication should follow along the lines of responsibility and should be a two-way process, thereby providing a better understanding between all concerned.

All these processes combine to form the whole structure of management and it must not be thought that each process is independent; all are closely interdependent.

6.3 Involvement of the Supervisor/Foreman

The foreman's tasks are concerned with the production and is, therefore, greatly involved in Co-ordinating, Controlling and Motivating.

The seventh process - Communication - being the common denominator of all group activities provides a means of contact between departments or sections of a firm and individuals.

Note:
Communication is equally important at all levels within an organisation from senior managers to foremen.

The relationship and some idea of the degree of involvement has been depicted in **Figure 6.2**.

6.4 Role of the Supervisor/Foreman

The General Foreman/Supervisor has approximately 70% of his duties being purely technical and 30% administrative.

The keynotes of his duties are leadership and co-operation; adequate knowledge of the principles governing the work of other departments in the organisation will enable him to carry out his function with due appreciation of their respective values in the general scheme of production.

He has four main industrial responsibilities:

- Carry out in detail the general policies formulated and instructions issued by the management;
- Assist in ensuring complete satisfaction of the client, by maintaining a quality of workmanship of high standard and honouring contractual completion dates and conditions;
- Recruit, train and maintain a contented and competent work team;
- As far as his limited responsibility extends; he must contribute towards the permanent prosperity of his firm by ensuring that on all work undertaken profits are achieved.

We've shown that his duties are also administrative – he is an important link in the chain of administration. The top management depend on him to carry out some of the most important work in the organisation, namely, at the point where the application of the firm's principles of production, organisation and planning are implemented, ie, the work site.

His importance to management and the building industry is being more widely recognised daily. Management, despite it being competent generally and exercising improved planning and providing wage incentive with improved working conditions, can only be partially effective unless the foreman can put these factors to the best use.

If he does not know how to put these "tools" given to him to good use, takes unkindly to programme ideas and cannot move with the times, he will fail as a foreman.

Since the application of labour and equipment on a worksite is the final phase in a building project the general foreman is placed in a position where he can see from one day to the other just how effective his firm's management and the efficiency of its organisation and planning is.

It is thus important for him to know in detail the precise responsibilities of all who are concerned with the building project and its planning so that he can bring to light shortcomings in management and the operation of its organisation.

Note:
Just as the supervisor/foreman must eliminate poor workmanship and bad discipline within his own sphere of work, he should at all times be alive to faults resulting from indifferent management or poor programming imposed upon him.

In all cases the essence of successful general supervisor/foremanship is to bring weaknesses or faults to the notice of those responsible in a tactful and diplomatic but persistently positive manner until action is taken to remedy them.

6.5 Efficient site administration and it's effects upon production

The primary function of site administration is to promote good organisation and co-ordination of all building operations.

Note:
It has been firmly established that efficient organisation and good co-ordination exercises a decisive influence on productivity and in production cost in all industries.

However, in most industries the application of effective organisation has been relatively straight forward due to the main advantage of having the production processes housed comfortably and permanently in one situation and thereby enabling all services to be permanently established.

6.5.1 Difficulties of site management

The management of a building contract faces many other special problems which do not exist in a factory, and are almost unique in industry generally.

In a factory the management gets its orders from outside; once placed, the order are not often varied, and within the factory management has complete control subject only to inspection and compliance with satisfactory regulations.

On a building site things are very different. The contractor is liable to constant interference by alterations ordered by the architect on behalf of his client during the progress of the work. He also has to co-ordinate the worlc of many subcontractors, often chosen not by himself but by the architect.

There may be many sub-contractors working on a single building, each employing his own labour. The co-ordination of these numerous gangs of men working under independent firms is a task of the utmost difficulty, unique to the building industry.

The builder's contract must be carried out on the owner's site, wherever it happens to be, often far from the builder's headquarters, and generally in the open air. Most of the work is exposed to the weather; work is knocked off when it rains.

This can be a sore point, particularly in periods of bad weather, causing bad feelings and demoralisation.

Welfare facilities up to the standard that exists in a good modern factory provision of canteens, toilets, first-aid, facilities for games and for rest - are difficult to provide on a site which 1nay be occupied only for a few weeks and hardly ever for more than a few months.

Another difficulty is that the volume of orders on the books of any one firm fluctuates from time to time more violently than in most industries; a large

contractor may employ several hundred men at one time and only 100 a few months later.

The average period of employment of some craftsman on a single site may be only two or three months. The contractor has, therefore, little opportunity for building up a loyal team of workers comparable with what can be done in a factory where work is regular.

Compared with factory conditions having all the economies of efficient plant and machinery, of good supervision and good conditions of work and welfare, the problems are incomparably more difficult.

Note:
It is considered that there are no problems of labour management so difficult as those which confront the building contractor on a large and remote site.

For these reasons the problems of efficient and economic site organisation have been difficult to solve and insufficient serious consideration has been given to the organisation of site staff in the past.

6.5.2 Type of site management

The division of responsibility varies greatly in the different sizes of organisation, but no matter what size the organisation, the site problems are the same in principle, and no matter what the size of the contract or development the functions of the site supervisor are similar.

At one extreme the site supervisor may be a travelling foreman who acts in this capacity on several sites with only a working trades foreman resident on each site.

At the other extreme the site supervisor will be a fully experienced and qualified contract manager, possibly a qualified engineer, with assistant managers, general foremen, engineers, surveyors and a complete recording staff resident on the site able to fulfil all the functions which constitute an economic and efficient site organisation.

Between these two extremes and applicable to the majority of contracts, the site supervisor is normally a resident general foreman usually with a very small staff under his direct control, and is relying on visiting staff to deal with some of the aspects of site organisation.

6.5.3 Qualities and experience of site supervisors

Whatever the form or size of organisation, the site supervisor, must be fully aware of all aspects of the work and, have day to day knowledge of progress, productivity, costs, and many other matters to enable him to achieve economy in the production of a building.

The method of obtaining this information will depend largely on the degree of direct site control permitted by his head office.

From the above it will be appreciated that the responsibilities of a general foreman or site agent are many and therefore it is essential that his knowledge and experience should not only be technically sound but that he should be a good administrator, diplomatic and tactful.

The position involves responsibility not only for the expenditure of a large sum of money but also for maintaining the reputation of his firm which will be judged on the quality of the work and adherence to programme.

Note:
It is important that the site supervisor should have close and direct contact with the architect and, where appropriate, with the engineer responsible for the design of the structure.

6.6 Efficient site administration – effect and means of achievement

The effect of efficient site administration is to produce:

- Sound workmanship
- work constructed at a fast rate of progress
- Work constructed at low cost

The means of achieving this are various and can be summarised here as follows:

6.6.1 Labour control

The biggest single factor to ensure that labour costs are kept down and productivity kept at a high level is efficient labour control. The procedures to be introduced would include ensuring that men arrive and depart only at the proper times and are paid only for the hours of attendance on site.

6.6.2 Full utilisation of plant and equipment

Mechanical aids should be introduced wherever possible as they will not only expedite work, but will ease labour problems.

Moreover, the use of machines greatly assist the prediction of output rates which is a vital factor when working up to a programme of closely integrated operations. It should be ensured that equipment is on site at the appropriate time, fully utilised and well maintained whilst on site, and returned immediately it is redundant.

6.6.3 Material supplies

Consistently good production is dependent upon the maintenance of an adequate and regular supply of materials to the site. The onus of maintaining supplies rests largely upon the ordering department of the builders organisation.

Delays in deliveries of materials is a factor contributing to low production. The presence of adequate stocks of materials, over and above immediate needs, is an assurance of continued employment and a definite encouragement to high productivity.

Note:
The supervisory staff will want assurances on material deliveries both with regard to quantities and dates to enable them to adequately plan production for their own operatives.

6.6.4 Safety and welfare

A clean and tidy site is another important condition in promoting and maintaining good organisation and every effort should be made to stack, store and protect materials in a safe, clean and orderly manner to avoid waste danger and loss.

Close attention to the welfare and safety of operatives, particularly during winter months, will establish goodwill, reduce labour turnover, and at relatively small cost pay dividends in higher production.

6.7 Implementation of site policy and procedure

One of the biggest contributing factors towards effective control is the devising of procedures throughout the work. A procedure being defined as "a pre-determined course of action which is standardised to meet certain recurring situations".

Note:
Once procedures have been instituted it will be seen that construction control or contract supervision is a matter of checking and cross checking.

The following are most of the aspects on which procedures are required:

6.8 Planning and programming

A considerable amount of unproductive time can arise through lack of planning and or co-ordinating the work of the various trades involved. The detailed planning of production before the contract is started, is an important factor in good site organisation.

Note:
The basis of effective planning is a programme.

When programmes are completed, it is desirable before they are finalized to call together those trade foremen and leading hands who will be responsible for

implementing them, and to discuss all aspects such as materials supplies, plant requirements, labour force, production rates and so on.

From a discussion minor adjustments to the draft may be necessary to ensure the fullest co-operation from all concerned.

6.9 Site planning and preparation

As soon as the contract is signed and the site supervisor appointed, his first task will be to apply for or to ensure that application has been made for a telephone line to the site, for a main water supply and, where necessary, a supply of electricity.

He will then completely plan the site in relation to his intended organisation, deciding the relative locations of facilities, accommodation, and plant to provide the best conditions to achieve maximum economy, continuity and safety during building operations.

Full regard must be paid to the following considerations:

6.9.1 Access and traffic routes

Requirements vary greatly with the types of project, its location and the stage of the job; access from a main road should be duplicated where possible, providing one way traffic and encouraging "flow".

Temporary approaches may be constructed of hardcore, sleepers, concrete, etc. Routes to spoil tips must be frequently repaired and attended to: pavement crossovers must be provided and excavated material kept constantly cleared from adjacent highways.

Note:
On extensive sites vehicle check points may be necessary at exits for security reasons.

Permission must be obtained from the local Authority for access over, or encroachment on pavement footpaths, traffic, and police must be notified if roads are to be closed or diverted or metered parking places closed.

The erection of fences may be required, watching and lighting supplied, pedestrian walkways installed or vehicle tracks provided over trenches.

6.9.2 Materials storage and handling

Stores and compounds must be provided for tolls and equipment, plant spares, and breakable or attractive components or :materials, while storage areas must be designed for bulk items such as bricks.

Note:
Special attention must be paid to materials, like cement which must be protected against moisture and goods which require careful stacking to prevent deformation, eg windows.

Newly completed buildings or rooms can often be utilised and it may be helpful to construct garages, etc. early in the programme for this specific purpose.

A site plan should show not only the location but sizes of stacks, dates required, planned routes for distribution and the eventual destinations. Sub-contractors' needs must be remembered, and suitable space allotted for their huts and materials.

Security must be considered, including locked buildings, adequate fences with gates, the careful location of checkers' huts, procedures for stores receipts and issues, fire precautions and the employment of a night watchman, etc.

Economical methods of materials handling include the employment of bulk cement, conveyors, off-loading gantries, etc., and a minimum unloading gang.

6.9.3 Administration buildings and facilities

Environment is of great importance to clerical work, so that the siting of administrative offices both for the contractor and the clerk of works or resident engineer, require due consideration in order to find the right compromise between the convenience of a view overlooking the works and freedom from the noise of welfare facilities also make a real contribution to production so that the requirements of a tuck shop, changing rooms and toilets must be properly provided.

6.9.4 Plant, workshops and services

The choice of major items of plant is of real consequence on most sites, and their use on the site is of equal importance, and may involve the careful balancing of plant to labour for most operations and the exact positioning of the machines.

If a tower crane is to be used, the position must be decided upon, or its position in the building if it is a climbing crane, and relate the position of bulk materials and mixing points to the areas which can be reached easily by the end of the crane jib.

The type of scaffold to be used must be decided and quantities calculated.

Existing services should be pinpointed to obviate disruption and the routes of new ones taken into account when siting temporary buildings and roads.

6.10 Organisation and supervision

After the plant and installations have been arranged the human organisation must be considered.

6.10.1 Staff and supervision

The type and number of staff must be decided and also their responsibilities and relationships.

On technical supervision the trade foremen or leading hands will need to make themselves fully aware of the specification for those parts of the work for which they will be responsible and to discuss and agree with the site supervisor the method to be adopted in carrying out the work.

Note:
A timekeeper will ensure men are recording on and off at the appropriate times and trade foremen will ensure that men are carrying out the tasks required of them.

6.10.2 Progress

The general foreman should keep a site diary to record progress and unusual occurrences. Physical progress can be marked up and recorded on programme charts.

6.10.3 Variations

It is almost inevitable that a number of variations will occur as the contract proceeds. In order to ensure financial adjustment may be amicably settled, and drains and services, etc. shall be recorded "as built" for future reference, it is imperative that all charges should be methodically agreed and measured.

Works not immediately measurable can be recorded on day work sheets. The prompt adjustment of variations is advantageous to all parties and is greatly assisted if the relevant information is readily available.

6.10.4 Communication

Good communications systems are vital to effective control, and modern systems range from two-way radio, telephone, siren, etc.

6.10.5 Co-ordination

The process of linking together various members of the team.

If there is no clerk of works on the site the architect may require weekly site reports from the general foreman.

For co-ordinating the work of senior site staff, weekly meetings of site supervisory staff with chosen sub-contractors under the informal chairmanship of the general foreman are a good way of exercising control.

6.10.6 Sub-contractors

An indispensable factor in good site organisation is the full cooperation of sub-contractors and their ability and keenness to co-ordinate their work into the main contractor's building programme.

To facilitate this co-operation it is essential that sub-contractors be selected as early as possible so that their ability to commence and complete their work during a specific period may be known before work programmes are finalised.

Note:
Copies or extracts of all relevant programmes, drawings, schedules, instructions, etc. must be speedily passed on to the sub-contractors concerned.

In turn, their labour strengths and progress achievements should be recorded, and any labour, material or information difficulties noted and followed up. An initial site meeting to settle queries and discuss trade sequences and attendance requirements, can greatly improve cooperation.

6.11 Delegation

One of the most valuable skills of management. It is the art of getting another person to do a task of work, which otherwise, you yourself would be compelled to do.

6.11.1 Meaning of delegation

The means whereby anyone can free himself from detailed work to concentrate on those matters only which he alone is best able to dor or can more effectively perform.

But, anyone who has delegated to a subordinate cannot avoid any of his responsibility by doing so.

Delegation, or the scope thereof depend on the delegator deciding on certain factors:

- Must decide exactly what he is going to be delegating (ie the scope of the task must be specific).
- Must select personnel he can trust to carry out the task, also accept that the other person's way of performing it may not be the same as his, but not necessarily worse.
- Must ensure delegatee understands exactly what is expected of him.
- Must ensure that everyone else with whom the delegatee is likely to come into contact with, knows that tasks have been delegated to him.
- Must check occasionally to ensure that the task is being completed properly.

Note:
Details of the method of completion should be left to the delegatee but the overall control and responsibility remains with the delegator.

6.12 Responsibility

The handing over of a portion of his own responsibility to another while retaining overall responsibility to any higher authority. Accepting delegation is also accepting responsibility on behalf of his superior; he will be accountable to his manager for those duties (but his superior will be accountable to any higher authority).

6.13 Authority

It is the right to require action from others. When responsibility is delegated, it is necessary for the accompanying authority goes with it.

There are two main kinds of authority:-

- Authority which is derived from the position held (Authority of position).
- Authority derived from personal talents and personality (Authority of person).

Most workers are willing to do their job effectively if it falls within the normal scope of their trade (known area of indifference).

Weak leaders who do not instil confidence in the workers will find it difficult to motivate the workers when the scope of work falls outside this area of indifference, ie supervisors with good "leading" skills is essential to motivate his workers.

Note:
When selecting senior site staff, leadership qualities as well as trade knowledge must be taken into consideration.

6.14 Which tasks to delegate

To discover what tasks can be delegated, certain questions need to be addressed:-

- Can someone else complete the task faster/more effectively than you? (Make use of people expertise and knowledge.)
- Can someone else perform the task instead of you? (Even not as well, leaving you free to do something else.)
- Can someone else perform the task @ less cost than you? (Get a labourer @ R5/h to mix cement, not the foreman @ R20/h)
- Does someone else, who is able to complete the task, have time, when you do not. (Less than perfect job on time could be more valuable than a perfect job too late.)
- Could this contribute to developing and training someone?

Delegation gives a superior more time, allowing him to assume responsibility for a much wider range of activities.

The superior can free himself from detailed work, as long as delegatee is carefully chosen and knows exactly what is to be done.

Occasional checks are required to ensure the delegatee is completing the task properly.

6.15 Personal contacts on the site

Once the actual construction is started the foreman will come into contact with and become involved with other people outside his own organisation.

The people who will have the most influence on his work will be the members of the "design group", namely the client, architect, consulting engineers and quantity surveyor, others who will influence his work will be subcontractors, clerk of works and local authority officials.

In order that the foreman will be better able to establish and maintain proper relationships with these people their job will be reviewed, more especially as to their specific roles and duties after the actual construction on the site is commenced.

6.15.1 Contact between building owner (Client, Owner) and Foreman

On thinking about it the foreman will immediately realise that the building owner or client is the most important person in connection with a building project, for theoretically without him there would be no work, but as we will discuss later he will probably be the person - at least of the design group - with whom he will have the least contact.

6.15.2 contact between Client and Architect

Up to the contract stage the client has worked closely with his architect and consultants and the work has now reached the point where he agrees that the contract documents, including all drawings, bills of quantities and supporting documents fully describe the building be requires.

What is his role once the contract is signed? It is very limited. He has delegated to the architect to act on his behalf, he must never then override his authority by issuing instructions directly to anyone except the architect.

The client must, therefore, be available to his architect for any decisions; only in this way will the client ensure that his architect can maintain full control of the job.

Note:
As far as the builder is concerned the client's most important function is that he must pay within the time specified in the contract, usually monthly, those sums which are certified by the architect as being due to the contractor.

6.15.3 Contact between Client and Contractor (Builder)

In the case of the client employing an architect, the only contact which takes place between the building owner and the builder is when the contract is signed and possibly when periodic and final payments are made.

In the analysis of personal contacts on the site as they affect the contractor or builder, it will be necessary to subdivide and classify contractors in the industry as a whole into the three main categories encountered under present-day conditions.

Small firms

These firms consist essentially of the contractor, employed tradesmen and the labour force. The builder himself is concerned with the execution, supervision and planning of all the work done by the firm.

Little delegation of authority in the true sense is exercised, and communication is directly between the builder and any parties involved in any contact with him.

This is a small, compact organisation under the direct control of the builder, with very little specialisation of functions, every member changing his tasks as and when required, in the interests of overall productivity.

Medium firms

In the medium firm, the contractor concentrates on management and delegates the responsibility of supervising work on the site to the foreman.

Communication on the site will thus be with him from architect, trade foreman and sub-contractors, and from him to the architect, except in cases where the employer's presence and authority are essential.

Large firms

The contractor now can no longer be concerned with the detailed supervision of sites. His main concern will be that of master planner, not in respect of any single project, but in the general development and expansion of the firm.

Delegated authority is more advanced and site control is delegated to a general foreman who, in turn, is assisted by a number of trade foremen.

The organisation will comprise departments responsible for specialist matters such as staff and accounting, as well as technical planning, design and supervision of production work.

Communication would be, as far as it affects the work on site, between contracts manager, engineer and the supervising architect through the clerk of works and foreman back to the contracts manager.

6.15.4 Contact between Client and Site Supervisor

As stated previously the foreman will possibly have very little contact with the client and, on most contracts, the client will have no automatic right of access to the site.

However, obviously he will be the person most interested in the progress of the job and adequate opportunity should be allowed him to inspect progress.

These visits should be made in the company of the architect or only after proper permission is sought or requested from the builder or site supervisor.

One cannot invoke the full terms of the contract in this respect unless the client is being unreasonable, for it is only human for the client to be intensely interested in the progress of his project.

Note:
It also bears repeating that having commissioned an architect the client should refrain from giving direct instructions to the builder or supervisor or men on the site.

6.15.5 Supervising owner

There will occasionally be the case with some smaller contracts where the client may supervise construction himself and, in consequence, there will be a close relationship between the client and the builder.

6.16 Architect's pre-contract duties

6.16.1 Preliminary enquiries

The client will approach an architect, having first selected him either by recommendation or through social contacts, and arrange for preliminary discussions about a proposed project and will centre around:

- His needs (accommodation, etc. required).
- His resources (construction budget).
- Depending on the size of the job the architect will advise on the desirability of commissioning consultants to design specialised parts of the project, ie Electrical Installation, Air Conditioning, Structure, and possibly a quantity surveyor to advise on financial matters.
- The architect will then probably draft out a schedule according to the client's needs and resources and obtain agreement or point out any discrepancy which exists between them eg accommodation sought is too ambitious for budget; and ask the client to adjust them

6.16.2 Site inspection

Site would be inspected with client. Check if the boundary pegs are in position and a registered land surveyor's certificate available.

Examine title deeds of site. These will reveal if there are any onerous conditions and also if there are any servitudes such as drains, sewers, water mains or road accesses which could seriously hinder the development of the site.

Check with local authority whether there are any restrictions on the site in terms of any by-laws, regulations or any town planning scheme. Enquire also whether there are any road widening schemes or other future plans which may effect the property.

Check on what services are available or are likely to be provided at the site within a reasonable time; these would include water, electricity, storm water disposal, sewerage, telephone, access roads, etc. Take levels, make trial holes to ascertain bearing capacity and other physical characteristics of the soil.

The effect of prevailing winds. He should also note any adjoining buildings.

6.16.3 Sketch designs

Once all necessary preliminary discussions and investigations have been completed the architect's main productive task is to prepare sketch plans or designs.

Note:
Plans without elevations and perspective are not attractive but are usually provided as they give the client a better idea of what is being offered.

They should, however, be sufficiently complete to be able to prepare preliminary estimates.

6.16.4 Working and detail drawings

When the client has approved a scheme from the sketch designs; working drawings and all details are prepared. These are the production drawings one sees on the site. They are for the use of the quantity surveyor, contractor, foreman, etc, and should, therefore, be accurate in all respects.

6.16.5 Tendering procedure

When competitive tendering is resorted to, if the contract is reasonably large a bill of quantities method of tendering is used, in which case the nominated quantity surveyor will undertake the preparation of the bill of quantities.

When completed, a copy of the bill of quantities and a copy of the drawings is sent to all the contractors wishing to tender.

The contractor's estimators price the bills and submit their tender - which is their offer or bid to do the work - to the architect by a specified date and time.

Note:
Tenders are not opened before the stipulated time and unless special circumstances arise the lowest or most advantageous tender is accepted.

Once a selection has been made the bill of quantities submitted by the selected tenderer is presented to the quantity surveyor for scrutiny, checking and report.

Once the quantity surveyor's report is received the client will be informed and, if favourable, the contract should be drawn up and signed as soon as possible.

This completes the architect's pre-contract or pre-tender stage role. His post-tender duties are, incidentally, of more immediate interest to the foreman.

6.17 Post tender duties of the architect

When the contract is signed by the client and the contractor the architect's creative role virtually ceases and his task changes to one of supervisor, co-ordinator and arbitrator.

6.18 Supervision of architect

In general the architect's authority to supervise includes freedom of access at all times to inspect work done under the contract, not only at the site of the works but in the contractor's own workshops and also those of his sub-contractors.

He has the power to have uncovered any work which has been covered up without his inspection and approval. He has also the right to demand the removal and replacement of unskilful work and inferior materials. Basically supervision entails ensuring that all materials and workmanship are in accordance with that stated in the contract documents.

One aspect of site supervision is that failure to satisfy himself at the appropriate point in the contract does not give the architect the automatic right to have work corrected at a later stage, consequently the supervision should be thoroughly systematic.

Note:
It should not be overlooked by the foreman that site supervision also includes such things as checking on the general cleanliness and tidiness of the site. Food scraps and rubbish attract vermin and may cause trouble in the building long after the architect and contractor have left it.

6.19 Contract information from architect

In addition to the working drawings handed over to the builder at the commencement of construction, further drawings, schedules and information will be given to him by the architect as the job progresses.

For instance, final detailed drawings may not have been prepared for tendering purposes for such items as joinery fittings or other specialised equipment; colour schedules for such items as floor and wall tiling and internal and external paint decorations; ironmongery and sanitary fittings.

All this, together with any specifications, written instructions, or other contractual information must be available well in advance of the appropriate construction stages and it is his responsibility to see that the information is available and given in good time.

6.20 Certificates

Certificates are the architect's statement of the value of work done and the value of materials on site up to a certain date or stage of a building contract.

Contracts between builder and client provide for the preparation of interim certificates; so that payment can be made on account at monthly intervals or at various stages of construction.

Note:
It is the duty of the architect to actually issue the certificate, the value of which he calculates himself or obtains from the valuation of the quantity surveyor.

6.21 Variations

Modern building is such a complex operation that it is essential there should be a condition in the contract which will allow for any necessary changes to be made.

Variations or modifications arise primarily from a desire to make improvements or the need to make corrections. One of the disadvantages of the variation clause is that architects tend not always to crystallize their intentions on paper before the contract is signed.

They do this because they know that the variation clause will permit them to finalize their intentions during the term of the contract. A decision should be made that the variation clause should be used as little as possible, and then only for any unforeseen matters that may arise.

6.21.1 Architect instructions

The standard building contracts generally in use give the architect power to issue instructions referred to as "architect's instructions." It does not follow that every instruction is a variation.

Instruction must be confined to the following points:

- The variation or modification of the design, quality or quantity of the works or the addition or omission substitution of any work.
- Any discrepancy in the drawings or between the bills of quantities and/or drawings and/or specification,
- The removal from the site of any materials brought thereon under the contract, and the substitution of any other materials therefore.
- The removal and/or re-execution of any works executed under the contract.
- The dismissal from the works of any person employed thereupon.
- The opening up for inspection of any work covered up.
- The amending and making good of any defects under Clause 13.

Note:
The form of contract states that instructions must be given in writing or be subsequently confirmed in writing.

6.22 Convening of site meetings by Architect

Throughout the contract it is the architect's responsibility to convene "Architect's Site Meetings" to co-ordinate all on-site and offsite activities. Site meetings comprise one of the better control processes available to the architect, whereby the efforts of the design team and the construction team can be linked together to produce harmonious performance.

On small jobs site meetings can be a waste of time and are reserved for those occasions when the experience of a number of different people needs to be brought to bear on a common problem.

On large contracts site meetings are held at the start and regularly thereafter each month - or as required during the progress of the work.

Site meetings maintain the impetus of the job, help to avoid delays and can resolve differences before they generate friction and lead to misunderstandings.

There are more about site meetings later on.

6.23 Completion certificates

There are two stages of completion of a building contract, as defined in the standard Form of Contract.

- The first stage, described as practical completion, is the acceptance by the architect of the building as complete and ready for occupation.
- The second stage of completion proper, which usually comes three months afterwards, is when the building has been inspected for defects, the necessary corrective work carried out, and the final account settled.

As far as the foreman is concerned then, the true meaning of handing over is when the job is complete - all work should be complete and no work should be left for subsequent completion during the maintenance period.

Although the completion date is stated in the contract documents, many factors cause this date to be varied. For instance, the contract may be ahead of schedule, in which case the contractor will want to hand over the building as soon as possible; conversely, the contract may be delayed due to unforeseen circumstances.

When the date draws near and the foreman can foresee exactly when he will finish, the precise date should be agreed with the architect to enable him to make the numerous arrangements necessary to get the client properly installed.

The following are some of the items the foreman should see are attended to before handing over;

- All plant and equipment removed.
- All surplus materials removed.
- Windows and floors cleaned.
- All door locks checked and ensure that all keys are accounted for.
- All light bulbs fitted.
- All external builders rubbish and debris properly removed - not merely dug into the ground.
- Hake good all damage to adjacent property, fences and boundary walls, etc.
- Ensure that all sanitary fittings are clean and in working order.

Note:
Get the architect to inspect the building and list all items he requires to be done before the respective men are removed.

Ensure that the client are familiar with the positions of all stop cocks and main switches.

Three months after practical completion or as soon as the defects have been made good the architect finally inspects the building and, if all is satisfactory, issues a final completion certificate. There is an extended time of six months or until sufficiently tested by heavy rain, in respect of the roof.

6.24 Etiquette on site

When visiting the site, the architect or his deputy should follow the orthodox etiquette. If there is a clerk of works on the job, the architect should speak to him first. The clerk of works must never be allowed to think he is being by-passed or ignored.

He will very likely want to bring up some points before the inspection starts. Before making his inspection he must let the site supervisor know he is on the site and give him the opportunity to go round with him.

He must follow the correct lines of communication and not give direct instruction to workmen or sub-contractors' workmen. All instructions must pass via the builder.

Note:
The architect is the principle professional consultant in respect of a building contract and, as such the student should be fully conversant with his duties, particularly during the construction of a building.

Primary duties of the architect during construction:

- Periodic inspection of the work on site to ensure quality of material and workmanship are as specified.
- Issue variation instructions, revised or amended drawings.
- Issue of monthly or interim certificates.
- Convening of site meetings as may be necessary to coordinate all aspects of the work.
- Carry out final inspection and certify satisfactory completion of the contract.

Less obvious duties:

- To be available for discussion with-client during course of execution of his contract.
- Take full responsibility for the contract under his direction.
- To be available to provide guidance to those to whom the work has been delegated.
- The co-ordination of consultants and advisory services on the contract.

6.25 Clerk of Works

The position of the clerk of works differs from that of other members of the building team in that he is not a member of either the design team or the construction team.

He is officially appointed and paid by the client but acts under direction of the architect. He acts solely as inspector of the client.

Listed below are some of the duties of the Clerk of Works:

- He must have a thorough understanding of the interpretation of the condition of the contract documents.
- He will examine materials delivered to site, inspect workmanship as it progresses and correct it if necessary by giving the general foreman the applicable orders without consulting the architect unnecessarily.
- He must keep careful records of all deviations from the contract documents as well as work that were provisionally measured and that are subject to re-measurement by the quantity surveyor.
- He submits weekly reports to the architect, recording in it progress, plant and equipment, visitors to the site, the work of sub-contractors, and many more.
- He keeps a daily diary and instruction book stating everything that happened that day, including any variation from the architect.

6.26 Building inspector

In service of the local authority, municipality or town council. His task is to see that local regulations is carried out. He is to be informed of dates of completion stadiums of work which is to be inspected and approved by him before work can commence.

His approval is needed in the following:

- Foundation trenches before casting concrete.
- Damp-proof layers.
- Underground services eg sewage.
- Building inside building lines.
- See to the safety of the structure.

6.27 Quantity surveyor

During the pre-tender stage the QS advises the Architect on the estimated cost of his design sketches.

He prepares a complete Bill of Quantities once the Architect has finished his specifications and working drawings.

The QS sends out invitations to tender to contractors prescribed by the Architect. He also receives the priced tenders which are returned by the nominated contractor and check it for major mistakes. This becomes the complete list of the financial cost of the building.

Unless there are any changes this accepted tender is regarded as the final cost of the project. This sum is paid in interim payments according to completed work and material on site.

Note:
Retention is deducted from interim payments - 10% for completed work and 15% for material on site.

As soon as the contract starts the QS is responsible for preparing interim certificates and at the end the final account when all the conditions and schedule agreement contained in the Bill of Quantities are met.

The QS are nominated to do this work and is thus the only person allowed to perform this task.

He is the client's financial advisor, but works with the Architect and not the client. He has no direct contact with anyone on the site, but operates via the Architect. The Architect is notified of any meetings between the QS and the contractor through brief notes.

The QS, Architect and contractor reaches an agreement with regard to payments/interim certificates at the signing of the contract. This agreement includes the manner in which sub-contractors' accounts are handled.

This also includes the manner in which the subcontractor will be informed of necessary payments due to him via the main contractor.

The Architect is the only person who has the authority to instruct re-measuring of variations – work which changed from the original plans/specifications.

Work which is "provisionally" measured or primary cost items are automatically subjected to re-measuring without approval of the Architect. In this regard there is a give-and-take attitude between the foreman and the Clerk of Works.

Note:
The contractor bases all his measurements on information which is agreed and noted by both parties.

6.27.1 Pricing of variations

- All authorised variations shall be measured and valued by the Quantity Surveyor.
- Prices in the original bill of quantities are used to determine the valuation of new work, of similar nature, executed under similar conditions.
- Where the new work is not of a similar nature, or 'executed under similar conditions, the original prices are used as a basis for a new negotiated price.
- Where extra work cannot be properly measured or valued, or if agreement regarding the price cannot be reached, then the work has to be completed on a Day-Work basis.
- Prices in the original bill of quantities shall determine the valuation of items omitted.
- If omission vary the conditions under which any remaining work is carried out, the price for these affected items will have to be re-valued.

We can therefore conclude~

- The Quantity Surveyor gives financial advice to the Architect and design team, during the design stage and re-value variations.
- Conducts the measurement of variations for certification purposes.
- Must follow the orthodox etiquette.

6.27.2 Bill of quantities

- The quality and quantity of the work in the contract is set out in the bill of quantities.
- It is prepared in accordance with the latest edition of the Standard Systems of Measuring.
- The signed bill shall be the basis on which all adjustments and variations shall be measured.
- Any error in description or in quantity or omission shall be rectified and treated as a variation (the value thereof added or deducted from the total contract sum).
- There must be no alteration or modifications to the conditions of contract.

6.27.3 Unfixed materials

Any unfixed materials (value of which is included in the bill of quantities):

- May not be removed from site without Architect's authority.
- Must be insured against damage and protected against theft.

6.27.4 Measurement of provisional sums

- As the extent of certain sections of work is not known the bill of quantities preparation stage, these items are measured provisionally (ie QS includes estimated measurements of the items which can be reasonably expected).
- Provisional sums indicated in the bill of quantities must be omitted from the provisional account and replaced with the correct measured figures in the final account (if work is provisional no variation order are needed for further/varying work).
- Should provisional work be covered up and considered unmeasurable, the QS must discuss it with the Clerk of Works and general foreman and come to a mutual agreement as to a realistic figure.

6.27.5 Final accounts

- Last account of the project (All measurements and pricing of variations, adjustments, prime costs and provisional sums - against actual invoices - and wage fluctuations, must be checked and then agreed with the parties concerned).
- Contractor signs (signifying agreement) the statement which includes the final balance of money due to him.

6.28 Consulting Engineer

6.28.1 Duties of the Consulting Engineer

- *Civil Engineering Contracts*: Similar to that of the Architect on a building project. He is the principle professional advisor to the client both in the design and construction stages.

- *Building contracts*: Under control of an Architect, employed by the client. Will deal with problems in his field.

6.28.2 Pre-contract services:
- Offers an advisory service as a consultant to the architect. (Will design project for safety and to everyone's acceptance).
- Will negotiate with local authorities concerning the design and calculations of his work.
- Works with Architect and QS ensuring that the drawings and bill of quantities, etc include all aspects of his side of the project.

6.28.3 Post-contract services:
- Site supervision duties similar to the Architect (confined to his field of expertise).
- Available for discussions with the Architect to solve problems concerning his own work.
- Advises the Quantity Surveyor (amounts to be put in interim and final payments for work completed in his field of expertise).
- Responsible for organising equipment, testing facilities and reporting results to Architect.
- To attend those site meetings which are concerned with his work so that clarification, guidance or decisions over points of uncertainty can be given.

6.29 The foreman

A major problem facing the building industry in South Africa today is a shortage of foreman so qualified as to ensure the maximum use of manpower and machines to obtain the highest production of work of good quality.

In most cases the foreman has risen from the ranks, which is an advantage in that he thus knows much about the worker's jobs and is better able to appreciate their problems as well as recognise their weaknesses and strengths.

His appointment as a foreman will have been as a result of recognition in him of the following qualities:
- Leadership born out of technical skill, knowledge and experience,
- The ability to utilise his technical skill and knowledge in organising, directing, and controlling the work for which he is responsible.
- An appreciation of the need for continued improvement together with the ability to acquire experience and build on it.
- A capacity to allocate workers to their jobs and, where necessary, explain and show how the work is to be done, supervise them, including criticising or encouraging them as may be necessary.
- Willingness to accept the full responsibility of his position with its accompanying obligations to his employer, senior officials, subordinate staff and members of the various professions, local authorities and the public.

- Loyalty, beyond question, towards his employer as well as unconditional compliance with decisions made by his employer whether he agrees with them or not.
- Acceptance of his firm's policies as well as complete confidence in its integrity.

It is at this stage important to appreciate that we have, in the above-mentioned summarised items, dealt only with qualifications required of a person who rates consideration for a post of foreman.

These are based on aptitudes, training experience and technical qualifications but by no means constitute all that is required of him.

Where are factors based on human relations which, if given the serious consideration they warrant, will contribute towards overall success and achievement almost as much as those already mentioned.

Example

A foreman has risen from the ranks because he displayed qualities of leadership which, coupled with particular aptitudes, and skill, enabled him to be singled out from amongst his colleagues or fellow-workers for promotion.

He is familiar with all the trades and can thus appreciate the problems which arise besides giving him an excellent insight into his workers' weakness and strengths, as well as their likes and dislikes.

He is, however, untrained in dealing with the facts of a human situation.

His appointment as foreman is calling for qualities which he did not require on the bench or scaffold as an artisan.

His duties, amongst others, are also administrative in that he forms an important link between management and the labour force as well as the authorities and professions involved, in addition to being the operative link between planning and production.

He will be called upon to report on the progress of the work and advise his firm on matters affecting production.

Having therefore, become, as a foreman, a member of the management, he finds himself apart from the workers although he would probably prefer to be with them.

Leadership based on the setting of quality and pace of work, instructing the men, and by example showing them what to do will improve his social relationship with his staff and leave his authority unharmed.

On the other hand, he now finds himself on the lower end of the management ladder equally "apart" from the management and, in addition, having to "face the music" when anything goes wrong.

This double loyalty can be frustrating but need not be an obstacle to a happy relationship with his staff if he treats them as men like himself and ensures that his firm's policies are strictly carried out, and also looks upon himself as a means of communication between worker and management.

This should not, however, be done in the sense of his being a channel for grievances, but as an interpreter of the feelings of the workmen on the one hand and, on the other, of the aims and standards of the firm, or management.

Company policies vary from one firm to another but not human sentiments, and if a foreman is to achieve success, the following characteristics are well worth cultivating:

6.29.1 Loyalty and integrity

He will be loyal to his staff, encourage the good in them, stand by them and show faith in them. He will practise honesty in small, as well as big ways, avoid favouritism, and promise only what he can fulfil, and keep such promises.

6.29.2 Personal efficiency

In little things as well as big, personal efficiency will build up an example which will improve his as well as his firm's image.

A tidy office, work site, plant - neatness in general, together with a good quality of work on his part are of great importance.

6.29.3 Punctuality

It is essential for him to be punctual, because he cannot check or reprimand a person for being late unless he is on time himself.

Brutally honest self-analysis from time to time will improve his ability if he is aware of his own shortcomings and willing to do something about them.

Improvement can be brought about by study and intelligent application of the information given in this course, as well as appropriate books and periodicals.

Keeping himself informed on the latest developments in the building industry will be a credit to him, his employer and the building industry.

6.30 Characteristics of human behaviour

6.30.1 The need to belong

Every human being feels a need to be wanted and loved. Close ties of affection within a group provide the basic satisfaction of living. An employee feeling unwanted and rejected on the job becomes as much a problem as a problem child under similar circumstances at home.

6.30.2 The need for approval

Equally important to the average person is the need for approval of his work by his superiors. It will cause him to submit to control and abide by the requirements of his social group, thus avoiding criticism.

6.30.3 The need for status

A person strives to be accepted by his group and feel himself a person of some importance respected and admired by others. To satisfy this need many will work and compete with others without seeking any special rewards. Do we not often find a change in title giving a man more satisfaction than a rise in salary?

6.30.4 The need to achieve success

Most important is the urge to succeed, solve problems, conquer opposition, and in general master all situations is dominant in persons of ambition and will encourage high standards and time spent in learning.

6.30.5 The need for self-respect

A feeling of respectability and being a worthwhile, "good" type of person is of great importance to all humans. The most common personality shortcomings are feelings of guilt and inadequacy. A man will strive to retain his self-respect and often do almost anything to "save face".

How often do we not find someone rather resign from a good position when he feels his honour has been slighted.

They comprise joy, grief, shame, disgust and so on, and can be excited by a particular person, object, or set of circumstances.

An example often found is the worker under control of a foreman who shouts at him or rudely interferes with him. Such a foreman stimulates in the worker a form of hatred.

6.30.6 Know his workforce

It is pertinent, therefore, that to understand and influence the actions of a man, a foreman must know him as an individual and treat him as such, making the best possible use of differences in ability, aptitude, experience and personality.

He will know that peak production and high-grade standards cannot be obtained from a tired, untrained worker, and that attention to and praise for good work will ensure good results.

6.31 Supervisors

The main responsibi1ities of a supervisor may be summarised as follows:

- To ensure that the firm for i:>Ihich he works makes a profit.
- To ensure that workers are afforded good working conditions.

As regards the material aspect, the question arises as to how a supervisor can ensure that the job is a profitable one.

This will depend on his ability to organise and run the work, and this connection the following are the main points which have be aimed at:

- Sound workmanship.
- Work constructed at a rapid rate of progress.
- Work constructed at the lowest possible cost.

In order to achieve this, various factors in connection with organising the work have to be co-ordinated, so that the whole is balanced. The work will then, with proper supervision, run smoothly with resultant large output at low cost; if these factors are not attended to, chaos will probably result and the job will neither progress nor make a profit.

The supervisor is the contractor's representative on the site and is in control of organisation, of labour employed on site and of the work to be executed. He should be able to handle men and obtain maximum efficiency from them and also be able to select suitable men to occupy key positions under him.

He should be able to meet the architect and others connected with the contract and discuss intelligently the various problems which arise during the contract.

Duties of the supervisor:

- To co-ordinate the work of the contractor and sub-contractors and ensure that the contract time is not exceeded.
- To give instructions to the men through their respective foremen.
- To deal with problems arising from both contractor's and sub-contractor's work.
- To receive instructions from the architect or from head office and to put these into practice on the site.
- To work in conjunction with the clerk of works and to ensure that progress and quality of work are maintained.
- To use mechanical and other plant efficiently to expedite the completion of the contract.
- To plan site organisation in order to obviate double handling of materials and unnecessary re-siting of huts.
- To set out the building and provide levels when this work is not delegated to civil-engineering staff.

- To make daily reports to head office and requisition materials as required, and to keep records of weather conditions and verbal orders.
- To meet and discuss the items of building work with the architect.
- To record day-work items of building work and have the sheets signed by the clerk of works.
- To ensure that the work is executed in accordance with the planned programme-progress chart and to call the attention of the contracts manager to any variation from this programme.
- To advise head office of any labour requirements.
- To ensure that the work is executed in accordance with the planned programme-progress chart and to call the attention of the contracts manager to any variation from this programme.
- To hold weekly meetings with sub-foremen and contractors' foremen in order to discuss progress and for the week ahead.

It is the responsibility of the main contractor on a project to ensure that sub-contractors maintain a rate of progress adequate to fulfil their part of the overall programme. This entails regular checking.

Some contractors give sub-contractors a form on which certain information under the appropriate headings is called for, with a request for return of the form to the main contractor two or three days before site meetings.

The information from all subcontractors is collated and used as a basis for discussion at site meetings, especially when asking for details from the architect and consultants or co-ordinating the work of two or more sub-contractors and the main contractor.

Note:
The supervisor employed by the contractor is one of the senior site executives, and his function and his influence amongst the tradesmen on a site are such as to merit special consideration.

Successful management depends more and more upon the management of men rather than upon the organisation of machines of which the main concern is running. These machines operate efficiently when managed by ordinary human operatives, and this demands an ability to control and manage men.

Efficient output is due to leadership, not a bevy of experts and it is this quality which leads, guides and directs the organisation to the fulfilment of a predetermined task, hence personnel is its chief concern.

Such persons should possess the following qualities:
- Knowledge of the job
- Intelligence
- Initiative
- Keenness and loyalty
- Ability to inspire others to produce quality with quantity

This requires:
- The power of leadership, ie the ability to foster teamwork
- Creative imagination
- Intellectual sincerity and moral courage
- The power to co-ordinate with others
- Knowledge of administrative principles
- Capacity for delegating authority
- Sound technical knowledge

Moreover, the power of leadership could be sub-divided into the following:
Reliability
- Knowledge of the personal characteristics of his associates
- Willingness to receive suggestions
- Ability to criticise without antagonising
- Ability to make just decisions at all times
- Possession of a just, honest character

So much for generalities; some of the practical aspects are:
- At the outset of a job, study and assimilate in broad manner the site plan, working drawings, bill and specifications.
- Visit the site, make a sketch of the proposed layout, then think it over and it will be found that when the time comes to undertake the site works, most of the major difficulties will have been foreseen and preliminary operations should go like clockwork.

A wise policy is to be provided with a note book containing two copies, one of which will be sent to head office, one to the Clerk of Works and one retained; These records of extras, discrepancies, variations, points of construction or errors ensure that these factors are not lost or obscured by the time the end of the contract is reached.

Any decisions or specific instructions by the Clerk of Works should be confirmed as soon as possible, especially in the event of these instructions involving extra expenses or expenses which are due to discrepancies between bill and specification.

Note:
All day-work should be adequately described on day-work sheets and passed to the clerk of works for signature daily. Records of materials must be kept and checked.

Statutory notices required by the local authorities should be submitted when due, and finally record, in a diary, notes of weather, architect's or engineer's visits, with special mention of any verbal orders.

With regard to the sub-contractors, ensure that adequate storage space is provided to meet their requirements and that any special facilities required by them such as the use of a crane and in some instances additional labour, is provided when required.

Provision is made in the bill for contractors to tender for fixing and attendance and any other facilities provided to specialists and sub-contractors; and invariably stipulates that attendance is to include the use of erected scaffolding, plant etc, required in connection with all PC or provisional sums, and that the contractor shall leave erected scaffolding in position until and during the period required by the works of such items.

Activity 6.1

1. Describe the principles of administrating a building site.
2. What are the effect of site administration on a) production b) formulating site policy and c) procedure.
3. What are allotment duties?
4. How are responsibilities delegated on a building site?
5. Explain personal contacts on the building site with regard to a) Employer b) Architect c) Consultants d) Building Owner and e) local authority officials.
6. What qualifications and personal characteristics are required for a) supervisors and b) foremen?

Self-Check

I am able to:	Yes	No
• Describe the principles of administration		
• Describe the effects of efficient site administration upon the following:		
o Production		
o Formulating site policy		
o Procedure		
• Explain allotment duties		
• Describe the delegation of responsibilities		
• Describe personal contacts on the site regarding:		
o Employer		
o Architect		
o Consultants		
o Building owner		
o Local authority officials etc		

• Describe the qualifications and personal characteristics required in:		
o Foremen		
o Supervisors		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 7

Contract Documents

Learning Outcomes
On the completion of this module the student must be able to:

- Describe the different types of contract documents
- Describe the uses of:
  - Drawings
  - Specifications
  - Bills of Quantities
  - Tender documents

7.1 Introduction

The contract for the construction of works binds the contractor to construct the documents and the employer to pay for them. It describes comprehensively what the works are and how payment is to be made.

The works are often complex, involving the contractor in thousands of different operations and requiring him to buy hundreds of different manufactured items and materials and to employ a wide variety of men and machinery.

Hence the contract documents comprise a number of documents, as follows:

- The *contract drawings*, which pictorially show the works to be built, their dimensions, levels, etc.
- The *specification*, which describes in words the works to be built, the quality of materials and workmanship to be used, and methods of testing, etc.
- The *bill of quantities*, which sets out the expected measure of each operation of construction as calculated from the drawings, classified according to trade.
- The *general conditions of contract*, which define the liabilities, responsibilities and powers of the employer, contractor and engineer, and cover such matters as methods of payment, insurance, liability of parties to the contract, etc.
- The *tender*, which is the signed financial offer of the contractor to construct the works in accordance with abovementioned.
- Any *letters of explanation*, which are agreed between the parties to the contract as elucidating or amplifying their intentions with regard to the foregoing matters.

- The *legal agreement*, which is signed by both parties, confirming the respective intention to have a contract: between them as defined by all foregoing documents.

7.2 General description

When the owner/client and his commissioned architect have agreed upon a sketch design and the approximate estimate of cost for completion, the architect proceeds with the working drawings.

Note:
Working drawings consist of plans, elevations and sections of the building with larger scale drawings to describe the whole construction and its finishing.

In addition, there must be a site plan which shows the entire boundary of the site, extending sufficiently to show the storm water drain and sewer connections to the municipal main sewer.

The purpose of a specification is to tell the contractor:
- The extent of the work he has to carry out.
- The methods he may or may not use in order to construct the works.
- The quality and type of materials that may be used.
- The workmanship that will prove acceptable.

A *specification* is provided to give information and instructions which cannot conveniently be shown on drawings. The preliminary clauses deal with such general matters as conditions of, and access to site, arrangements for the storing of materials, temporary services, rainfall, river flows, general geology, the employer's relationship with other contractors and his aims and requirements generally.

The *bill of quantities* is drawn up by the quantity surveyor commissioned by the owner/client. He prepares the bill to conform with the requirements of the Standard System. The bill must be as simple as possible and must fully describe the materials and workmanship called for.

The Standard System is employed to enable a uniform interpretation to be possible in tendering the bill must reflect the work to be done accurately and in sufficient detail, in order to give a clear idea of its nature as well as cost.

Note:
Anything that influences costs, indicated on the drawings or described in the specification, must be included and nothing left to be taken for granted.

Although materials must only be ordered from drawings, the bills provide a good guide and a provisional schedule of materials may be used as a basis for accelerating the placing of orders.

PROVISIONAL SCHEDULE OF MATERIALS

CONTRACT: Park Housing Estate DATE: 23.8.2010

MATERIAL	DESCRIPTION	QUANTITY	FIRM	DATE ORDERED	DATE REQUIRED	DATE RECEIVED	ORDER NO
Hardcore	75 mm – 50 mm	10 000 m³	Brown's	2.3.10			3/645
Portland Cement	Ordinary	400 pock.	Algoa				3/628

Figure 7.1

Conditions of contract provide information concerning the starting date and the contract period. For a complicated contract such as a large industrial installation, start and finish dates are sometimes given for each construction phase.

Activity 7.1

1. List the different types of contract documents and describe them.
2. What are the uses of a) drawings b) specifications and c) Bills of Quantities?
3. What are tender documents?

Self-Check

I am able to:	Yes	No
• Describe the different types of contract documents		
• Describe the uses of:		
o Drawings		
o Specifications		
o Bills of Quantities		
• Tender documents		

If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.

Module 8

Mass-Haul Programme

Learning Outcomes
On the completion of this module the student must be able to:

- Determine economically, the cut and fill for given plotted ground surface shapes using Simpson's Rule

8.1 Introduction

The natural ground surface is seldom suitable for an engineering project. The surface must be suitably levelled for playing fields, parking grounds or industrial sites; roads and railways must be properly graded; so that they are not too steep and do not consist of a series of humps and hollows; trenches for drains must be dug to correct slopes, so that the water will flow in the right direction.

8.2 Formation Level

In all these cases, and many more, ground must be removed from some places and added in others, to bring the new ground surface to exact predetermined levels. The removal of ground is known as "cut", and the addition of ground, as "fill".

Definition: Formation level
The level of the completed earthworks before the addition of any surfacing material or special foundations, is known as the "formation level".

In order to obtain correct formation levels, the depth of cut or fill at all points on the job must be known. In practice, it is usually sufficient to know the depth of cut and fill at the pegs which have been placed to demarcate the route, or where large areas are concerned, a grid of pegs may be placed specifically for this purpose.

The levels of all pegs must, of course, be known. In road works particularly sections are drawn, as described above, along the route to be traversed. From the sections the engineer is able to plan the most economical position, in elevation, for the new ground surface.

He draws the new ground surface on the section, maintaining correct gradients, and endeavouring, as far as possible, to balance cut and fill, so that the cut will provide sufficient material for the filling, without surplus ground having to be carted away, or filling material brought onto the job.

This work is greatly facilitated by the section, which gives a very clear picture of the requirements.

8.3 Grade

If the grade is, say, 1 in 25 (usually written 1:25), this means that there will be one metre rise or fall for every 25 metres of horizontal travel; or 4 metres per 100 metres. This is often referred to as a 4% grade.

Definition: Grade
The slope of the formation of a road or railway along its length is called the grade.

If the grade rises from the known point, it is a "rising grade", and if it falls, it is a "falling grade".

Stated as percentages, these would be a + 4% grade and a - 4% grade respectively. The difference in height between the known point and any other point may thus be calculated by simple proportion, provided the distance is known and the level of the unknown point is easily determined.

8.3.1 Side slopes of cuttings and embankments

The sides of a cutting or embankment cannot be vertical but must slope. The angle of the slope depends on the nature of the ground.

If a slope of 1:1 is specified it means that the angle of the slope will be 45°.

8.4 Calculation of cross sectional areas

In the construction of roads, railways, etc., the centre line of the construction is pegged on the ground. Existing ground levels are taken along the centre line at say 30 m intervals and levels are also taken at right angles to the centre line, at the same interval, at equal intervals across the full width of the road or railway reserve.

A longitudinal section of the ground profile is plotted, using the centre line levels. The vertical scale is usually 10 times the horizontal scale in order to give a clear picture of the ground profile.

The ground levels are plotted from a convenient datum line so that all the ground levels will fit onto the drawing sheet.

After plotting the longitudinal section it will be possible to design the formation level of the road or railway. Once the formation level has been fixed along the centre line, cross sections can be plotted also using an exaggerated vertical scale.

The cross sections show the proposed construction levels in relation to the existing ground levels.

Using the cross sections the area of excavation or fill can be calculated and is determined by using Simpson's Rule. The volume can then calculated by multiplying the area by the length of the excavation.

8.5 Calculation of areas and volumes of cross sectional areas

8.5.1 Simpson's Rule

a. Uneven intervals

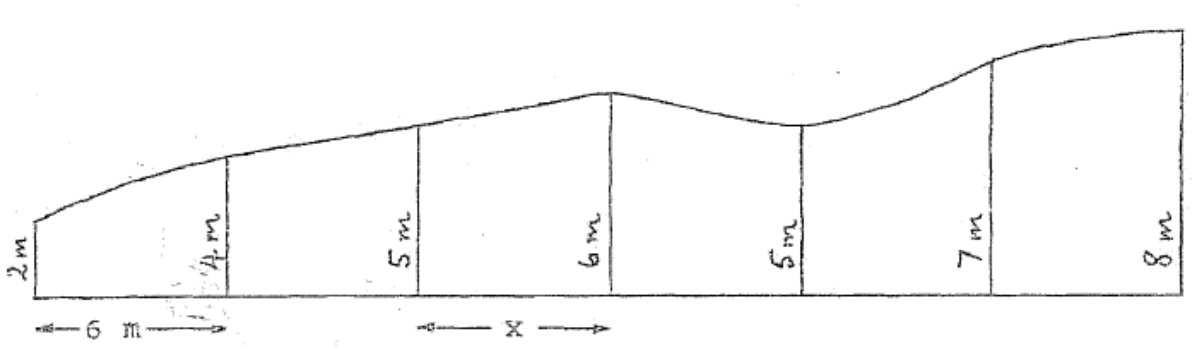

Figure 8.1

Area $= \frac{x}{3}\ [First + last + 2(unevens) + 4(evens)]$

$= \frac{6}{3}\ [2 + 8 + 2(5 + 5) + 4(4 + 6 + 7)]$

$= 196\ m^2$

Volume $= 196 \times length\ of\ road\ (5\ m)$

$= 980\ m^3$

b. Even number of intervals

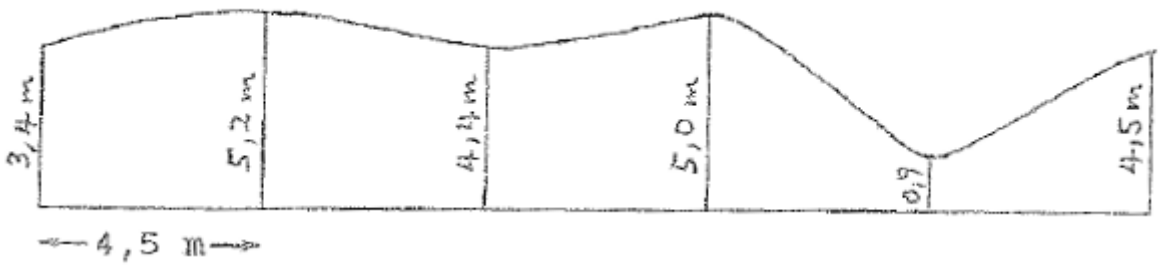

Figure 8.2

Area $= \frac{x}{2}\ [First + last + 2(all\ the\ rest)]$
$= \frac{4,5}{2}\ [3,4 + 4,5 + 2(5,2 + 4,4 + 5 + 0,9)]$
$= \frac{4,5}{2}\ [7,9 + 31]$
$= 87,525\ m^2$
Volume $= 87,525 \times length\ of\ road\ (5\ m)$
$= 393,863\ m^3$

8.5.2 Middle ordinate

$$Section\ area = \frac{the\ sum\ of\ middle\ ordinates}{number\ of\ ordinates\ \times by\ distance\ of\ section}$$

Distance (m)	0	1	2	3	4	5	6	7	8
Depth (mm)	0	300	400	500	550	450	400	300	200

$\frac{0+300}{2} = 150\ mm$ $\frac{500+550}{2} = 525\ mm$ $\frac{400+300}{2} = 350\ mm$
$\frac{300+400}{2} = 350\ mm$ $\frac{550+450}{2} = 500\ mm$ $\frac{300+200}{2} = 250\ mm$
$\frac{400+500}{2} = 450\ mm$ $\frac{450+400}{2} = 425\ mm$

Sum of middle $= 150 + 350 + 450 + 525 + 500 + 425 + 350 + 250$
Ordinates $= 3000\ mm$

Average depth $= \frac{3000}{8}$
$= 375\ mm$
$= 0,375\ m$

Cross section area $= 0,375 \times 8 = 3,00\ m^2$

Volume $= cross\ section\ area \times chain\ distance\ (20\ m)$
$= 3,00 \times 20$
$= 60,00\ m^3$

8.6 Mass haul diagram

The mass haul diagram offers a method of distributing an economical balance of material between cut and fill. It can also be used for a basis for tendering and can give an indication of which machines to select in the early planning stages of the project.

It can be used to calculate costs. In the construction of major roads and railways, the earthmoving phase of the project will often require the greatest expenditure of man ·hours and machine-time.

Machine selection for the economical operation of a particular project is of prime importance and should be based on:

- Quantity of material moved over each haul;
- Average haul distances;
- Total machine hours available;
- Machines and their outfit, available;
- Project specifications;
- Other requirements of the contractor.

The MHD provides a means of planning and controlling earthmoving. The MHD is a cumulative plot of required excavation and embankment quantities with respect to locations along the centre line of the project.

It is an aid in calculating and tabulating the quantity of earth to be moved and the average haul distances. Before attempting to tabulate earth moving volume and plot a MHD, it is necessary to be familiar with the terms of reference.

They are:

Profile
Graph of existing ground and finish elevations along the centre line.

Cross-section
End view, at any station, perpendicular to the centre line.

Figure 8.3

M^3(B)
Bank cubic metre, or one cubic metre of material as it lies undisturbed in the natural state.

M^3(L)
Loose cubic metre, or one cubic metre of material which has been disturbed and-has swelled as a result of loading.

M^3(C)
Compacted cubic metre of material.

Swelling factor
The factor with which undisturbed material will swell when moved.

Shrinkage factor

The factor with which material will shrink when compacted from loose volume to compacted volume.

Cut
Take away of material. Plotted as a (+) quantity.

Fill
Filling with material. Plotted as a (-) quantity.

Free haul
The maximum distance which excavated material is transported without extra charge. A contractor specifies his free haul distance when he submits his tender for a contract. (Bulldozer pushes the soil over this distance). Often set at 300 m but can go up to 800 m.

Overhaul
In excavation, a distance of haul in excess of the free haul. Extra charges are made for overhaul.

Average haul distance
It is taken as the length of the horizontal line that is placed midway between the balance line and the top (or bottom) point of the curve.

Excess material
Excavated material in excess and not to be used for project. It will be dumped somewhere else.

Borrow
The overall excess fill requirement is determined by the final position of the MHD below the baseline. The location of the points along the job where earth will have to be brought in from a borrow pit, is fixed by the choice of balance lines.

Borrow pit
It is an excavation dug to provide fill.

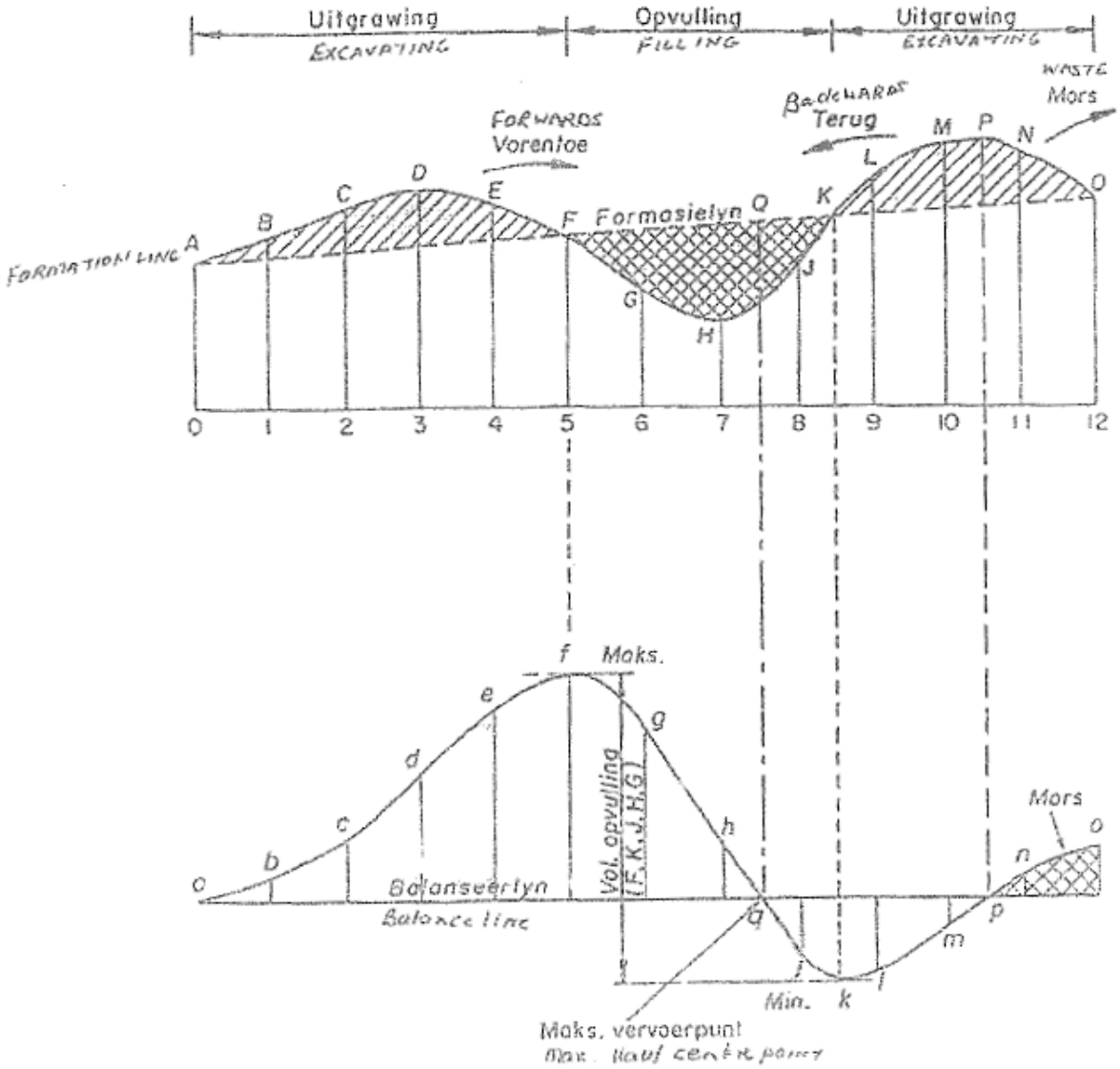

Figure 8.4 Mass haul diagram: Connection between longitudinal section and the mass haul diagram

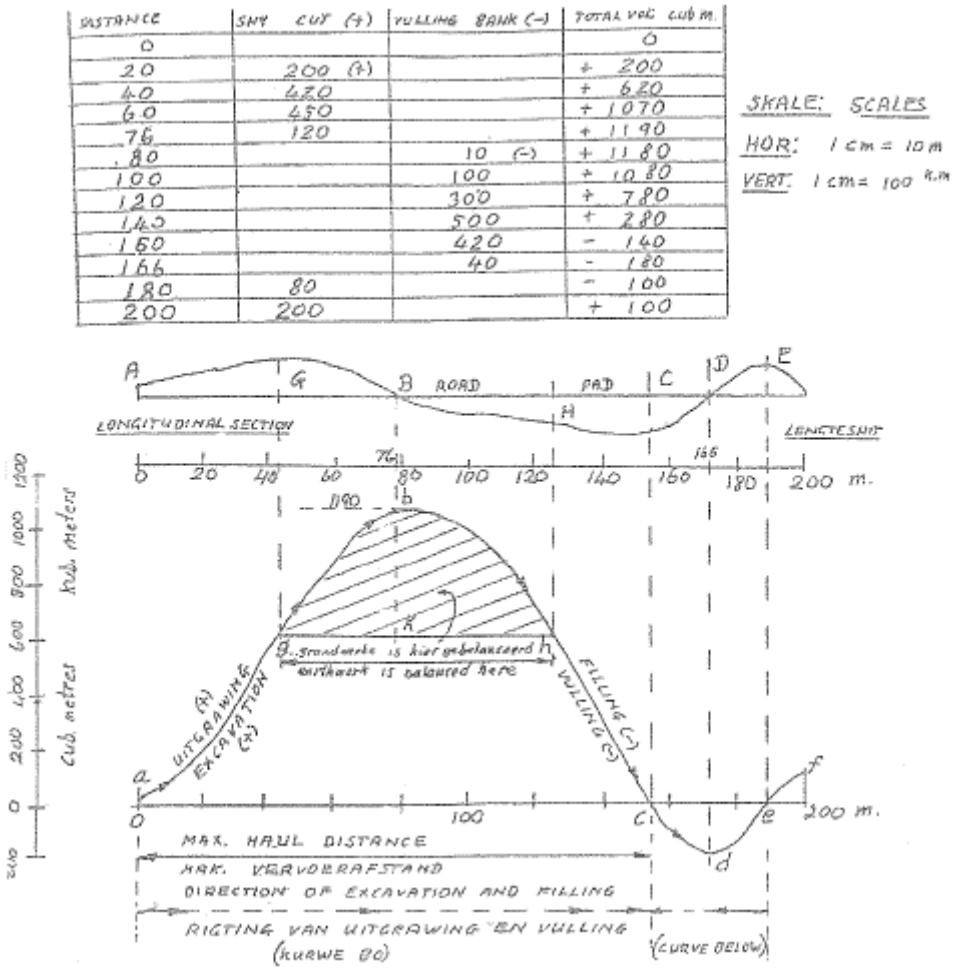

Figure 8.5 Mass diagram

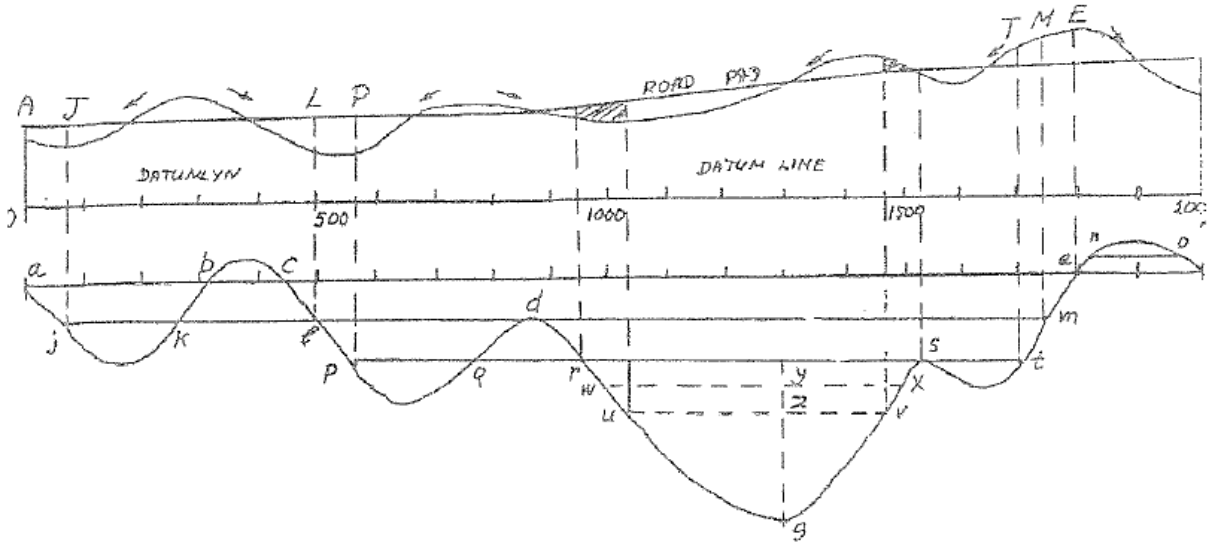

Figure 8.6 Mass diagram

8.6.1 Properties of a mass-haul diagram

- When the MHD is not a profile of the earth's surface.
- When the MHD is rising the operation is one of cutting (see a - f).
- When the MHD is falling the operation is one of filling (see f - k).

- Maximum points on the MHD indicates a change from cutting to filling (F - f).
- Minimum points on the MHD indicates a change from filling to cutting (K - k).
- The vertical difference between these points (f - k) indicates the volume of fill.
- Where the curve is cut by a horizontal line (a, q, p) , the balance line, the volume cut equals the fill.
- If the balance line cuts the curve, the area above this line indicates the volume earth to be moved forward and that below the line indicates the earth to be moved back.
- The length of the balance line between any two points indicates the haul distance between these points, eg a, q is the maximum haul distance forwards and p, q the maximum haul distance backwards.
- The area that is cut by the balance line indicates the mass haul in this area.

8.6.2 Limitations of the MHD

- The MHD is limited to a line structure. If a job is relatively wide compared to its length transverse as well as longitudinal hauls may be necessary. This cannot be shown on the MHD.
- The MHD assumes that all cut is acceptable for fill or that all excavated material is enough to fill. It also gives the haul distances. However, any attempt to get exact quantities and distances may be misleading. The MHD deals in overall quantities and average distances.

8.6.3 Properties and uses of balance lines

- The overall excess fill or cut requirement is determined by the final position of the MHD above or below the baseline. The location of the points along the job where earth will have to be brought in from a borrow pit or taking away for dumping is fixed by the choice of balance lines.

Definition: Borrow pit
Borrow-pit is an excavation dug to provide fill.

- The quantity of earthwork balanced between two balance points is measured by a vertical line extending from the balance line to the maximum or minimum point on the MHD for that section.

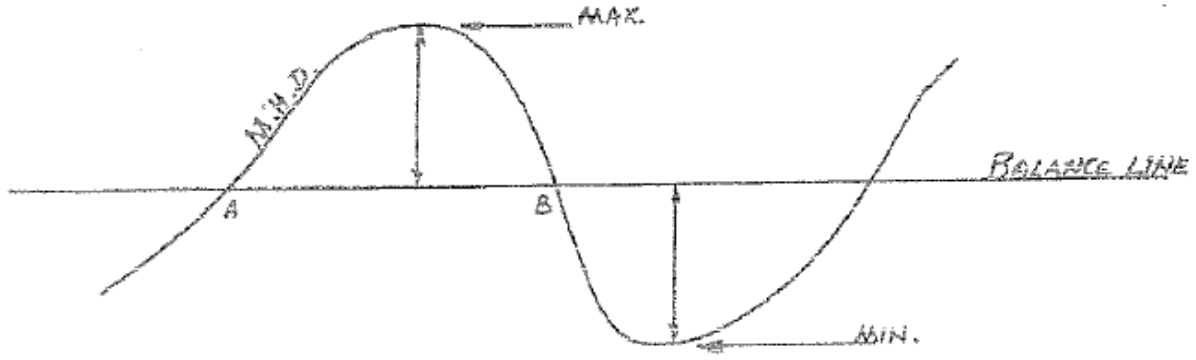

Figure 8.7

- In doing the balanced earthwork operation, ie in balancing cut and fill between stations A & B some of the distances will be short while others will approach a maximum haul distance.

  In the diagram AB is the longest possible haul distance for the balancing operation between A & B. The average haul distance is taken as the length of the horizontal line that is placed midway between the balance line and the top or bottom point on the MHD, ie a, b.

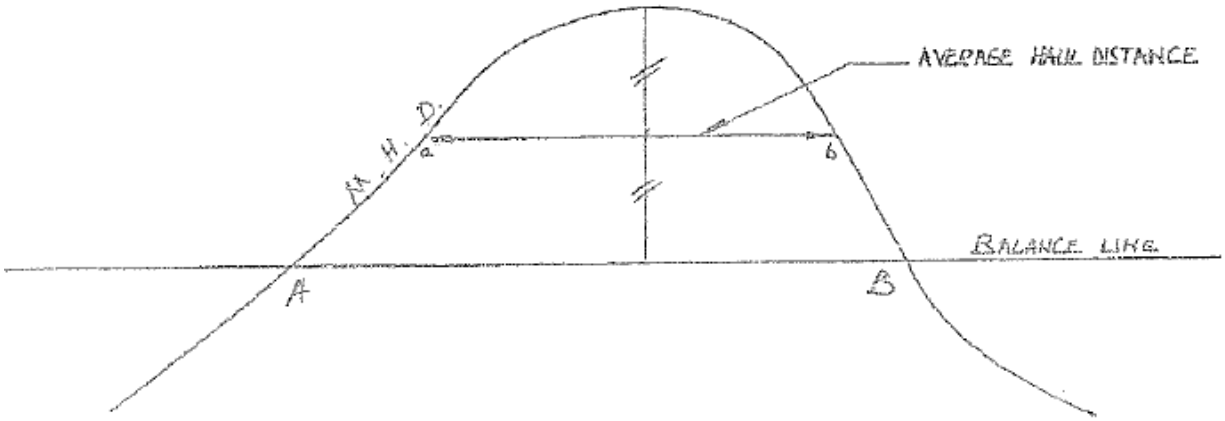

Figure 8.8

Definition: Haul
This is a distance (greater than a station increment) over which earth is transported.

- More than one balance line may exist for parts of a MHD. The same principles apply tor the area between the lines as for the case where there is only one balance line.

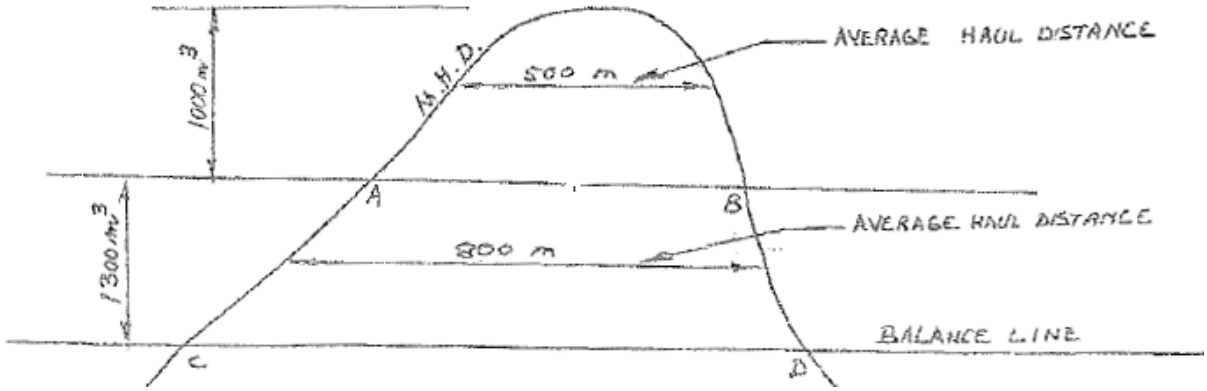

Figure 8.9

For the balancing operation between A & B a quantity of earth of 1000 m^3 is hauled an average distance of 500 m. This operation will be done first.

For the balancing operation between C & D a quantity of earth of 1300 m^3 is hauled an average distance of 800 m.

In the second operation cutting is carried out between C & A. The material then has to be transported past AB which will already have been done first.

Filling is then carried out between B & D. AB will be the minimum haul distance and CD the maximum haul distance for the second operation.

8.6.4 To determine the earthmoving summary sheet

Column 1 = Chainage distance
Column 2 = Excavating volume
Column 3 = Volume to fill
Column 4 = Shrinkage factor
Column 5 = $\frac{add\ the\ last\ two\ of\ column\ 2}{2}$
Column 6 = $\frac{add\ the\ last\ two\ of\ column\ 4}{2}$
Column 7 = $\frac{Distance \times sum\ of\ last\ two\ in\ column\ 2}{2}$
Column 8 = $\frac{Distance \times sum\ of\ last\ two\ in\ column\ 4}{2}$
Column 9 = Column 7 or 8 are just added (+ or -)

	**Note:** This information is used on the vertical scale to determine the MHD. The distances in metres on horizontal scale is projected from profile given.

	**Worked Example 8.1**

The following table shows the depths in millimetres at one chainage centre (1 chain = 20 metres) and stretches over the length of a road. The reading starts at the 3 000 metre distance and continues up to the 3320 metre distance.

DISTANCE IN (m)	3000	3020	3040	3060	3080	3100	3120	Cont.
DEPTH (mm)	0	200	320	400	440	455	440	

3140	3160	3180	3200	3220	3240	3260	Cont.
400	310	180	50	-50	-150	-250	

3280	3300	3320					
-305	-270	0					

Figure 8.10

The table shows ten positive depths, five negative depths and two zero depths.

(a) Draw a smooth continuous curve (graph) for the given values.
(b) Measure the middle-ordinates on the graph and then calculate:
    (i) the average depth for the excavation
    (ii) the average depth for the filling
(c) Assume that the slope over the length and width of the road is even, calculate:
    (i) the volume of excavated material
    (ii) the volume of the filling material required.

    Assume that the width of the road is 8,3 metres.

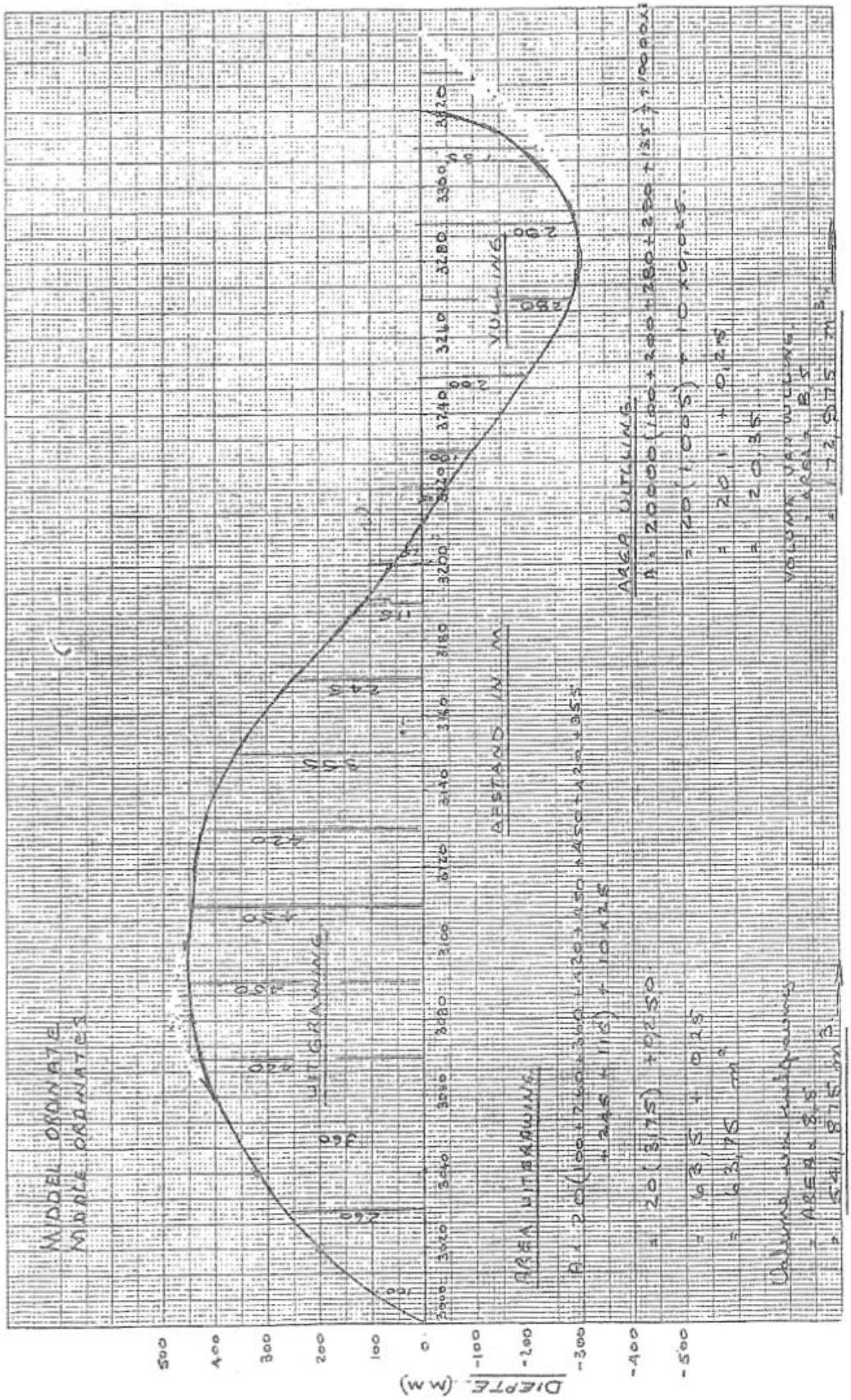
MIDDEL ORDNATE
MIDDLE ORDINATES
AREA UITWAWWE
AREA OUTLYING
DIEPTE (mm)
DEPTH

Figure 8.11

Practical: How to measure the slump

Materials and tools

- A sample of freshly mixed concrete (about half a wheelbarrow full)
- A wheelbarrow and shovel
- A flat steel plate about 600 mm x 600 mm x 3 mm
- A standard slump cone
- A scoop
- A steel tamping rod, 16 mm in diameter by 600 mm long with one end rounded
- A small trowel (gauging trowel)
- A metric rule or tape measure

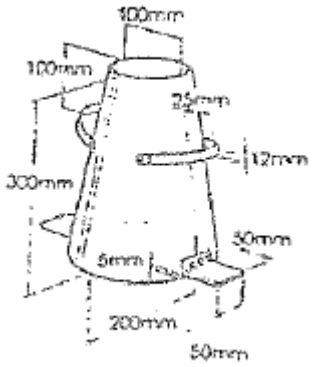

Figure 8.12

How to measure the slump

1. Mix the concrete in the wheelbarrow
2. Wipe all the tools with a damp cloth
3. Put the steel plate down on a level place so that it is firm, and then put the slump cone on it with the narrow end at the top. Stand on the foot pieces.
4. Fill the slump cone in 4 layers of about 75 mm. Tamp through each layer 25 times with the rounded end of the tamping rod.
5. The last layer should more than fill the cone. After tamping the last layer, use the trowel to smooth off the top of the concrete so hat it is level with the top of the cone.
6. Hold the cone by the handles to keep it steady while you step off the foot pieces.

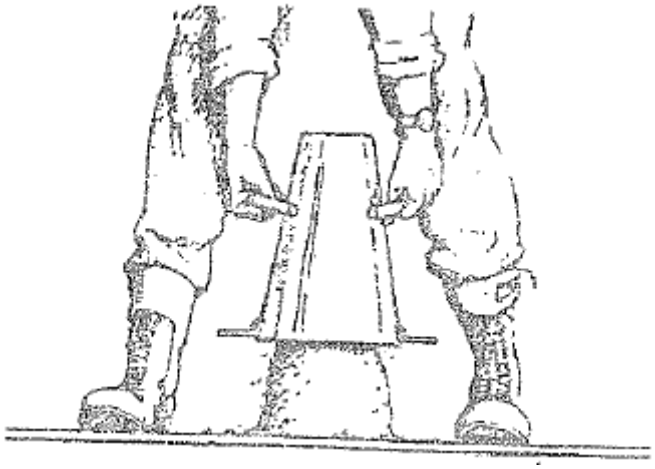

Figure 8.13

7. Slowly fill the slump cone straight up and off.
8. Turn the slump cone upside down and place it on the plate, next to the concrete.
9. Rest the tamping rod on top of the slump cone so that one end is above the concrete.

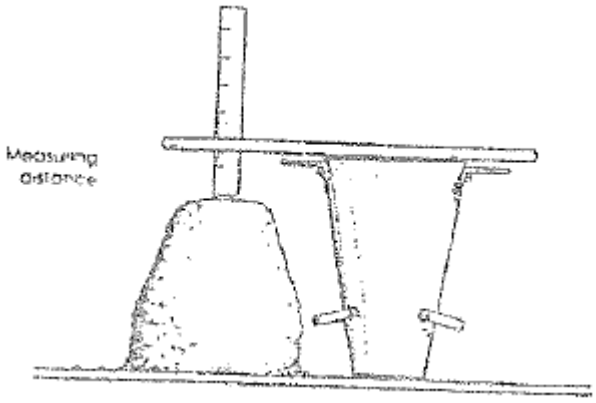

Figure 8.14

10. Carefully measure the distance between the bottom of the tamping rod and the middle of the top of the concrete to the nearest 5 mm.
11. If you don't get a normal slump, repeat the test. If the slump is still not normal, ask for advice.

Activity 8.1

1. Determine the cross section area and volume of excavation 6,5 m long.

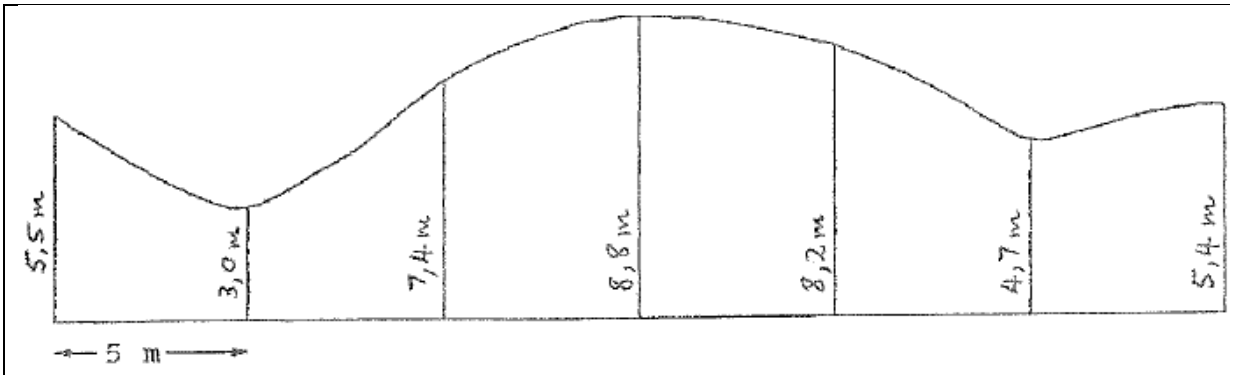

Figure 8.15

2. The following table shows the depths in millimetres up to the wanted depth.

Distance (m)	0	1	2	3	4	5	6	7	8	9	10
Depth (mm)	150	270	380	430	480	400	400	380	360	340	300

   (i) Determine with Simpson's rule the cross section area.
   (ii) Determine the volume of material to be excavated if the trench is 27 m long.

3. A piece of land is 960 m long. The width measured are shown. Determine the area in hectare. Use Simpson's rule (even).

Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
5	13	15	18	20	24	12	6

Activity 8.2

1. Calculate the accumulative volumes by completing the table shown in **Figure 8.16**.
2. Draw the MHD.

TABULATION OF VALUES FOR A MASS-HAUL CURVE								
STATION CHAINAGE	END AREA M²			AVERAGE AREA M²		VOLUME M³		ACCUMULATIVE VOLUME M³
		FILLING						
(1)	CUT + (2)	- (3)	x SF x KF = 1,1 (4)	CUT (5)	FILL (6)	(7)	(8)	(9)
0	0	0	0	0	0	0	0	0
20	0	-36	-39,6	0	-19,8	0	-396	-396
40	0	-30	-33	0	-36,3	0	-726	
60	0	-14	-15,4	0	-24,2	0		
80	30	0	0	15	-7,7			
100	28	0	0	29				
120	48	0	0					
140	26	-9						
160	0	-15						
180	0	-6						
200	0	-30						

Figure 8.16

Activity 8.3

1. Calculate the accumulative volumes by completing the table shown in **Figure 8.17**.
2. Draw the MHD.

TABULATION OF VALUES FOR A MASS-HAUL CURVE								
STATION CHAINAGE	END AREA M²			AVERAGE AREA M²		VOLUME M³		ACCUMULATIVE VOLUME M³
		FILLING						
(1)	CUT + (2)	- (3)	x SF x KF = 1,1 (4)	CUT (5)	FILL (6)	(7)	(8)	(9)
1200	0	0	0	0	0	0	0	0
12015	0	-32	-39,04	0	-19,52	0	-293	-293
12030	0	-8	-9,76	0	-24,4	0	-366	-659
12050	0	-33	-40,26	0	-25,01	0	-500	-1159
12060	0	-7	-8,54	0	-24,4	0	-244	-1403
12080	0	-14		0		0		
12090	30	0						
12110	13	0						
12122	47	0						
12152	25	0						
12180	53	0						
12200	17	0						
12215	48	0						
12220	16	-9						+2688
12230	0	-10						
12245	0	-19						
12260	0	-23						
12280	0	-30						
12310	0	-27						
12340	0	-32		0				
12370	0	-26		0		0		-1829

Figure 8.17

Self-Check

I am able to:	Yes	No
• Determine economically, the cut and fill for given plotted ground surface shapes using Simpson's Rule		

If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.

Module 9

Variations, Omissions and Extras

Learning Outcomes
On the completion of this module the student must be able to:

- Describe the various methods of:
  - Ordering
  - Storage
  - Control
  - Issue
  - Crediting of materials

9.1 Introduction

In any organisation the order of command is usually the formal communication channel and if it is open and direct, there is hardly any reason for delays or misunderstandings and the disputes arising from that.

Note:
In the building industry the general foreman is a key person in the order of command.

9.2 Site instructions

9.2.1 Receiving, issuing and recording of instructions

All instructions in connection with work on site, from his organisation or architect, will be directed to him. He will pass it to the trades foreman and deputy foreman who will then instruct the artisans and workers.

His firm has to acknowledge him as part of the management and make sure he knows his responsibilities and relationship with the rest of the personnel.

In every well developed organisation it is standard practice to hand out all instructions in writing.

Less important instructions which are given verbally to the foreman, must be accepted, but put into his daily diary for the record.

Instructions from architect can be divided into two categories, namely:
- those for variations and
- anything else he wants to issue

Architect can only instruct the foreman and clerk of works on site by putting it is the site instruction book. The foreman and clerk of works are the only ones who may report on these instructions.

Note:
When issuing instructions on site the architect should inform the contractor, the owner and the quantity surveyor by sending them a copy of the instructions.

The architect should mention the reasons for the variation of changes. It should also represent the items on the bill of quantities for correct measurement of work as it proceeds.

In his progress reports, the foreman can comment on the instructions received from the architect.

When receiving instructions and his own or nominated sub-contractors are involved, the main contractor has to inform all parties concerned in writing of all the implications that can result, eg the lengthening of contract period and insurance period, etc.

9.2.2 Day-to-day instructions to contractors

There are often daily occasions when it is necessary to inform, or make requests to, the contractor about the work. Some simple system of sending notes to the agent or members of his staff is necessary.

It is best to have only one book in use at a time, all staff writing their notes in it, the carbon copy which remains in the book representing a daily log of all detailed written instructions sent to the agent.

Many important matters can be dealt with in such a manner - notes about levels set out, notes about shuttering, types of material to be ordered, results of concrete tests, minor complaints and reminders, details of dimensions and setting out, elucidation sketches and so on.

The carbon copy remaining forms a useful record in many ways. It forms a kind of central notebook in which basic levels appear; The sketches and dimensions are useful for making alterations to the record drawings and for computing quantities of work done.

In addition, it forms an excellent "information bureau", enabling the supervisor to see in a moment or two what instructions his staff are currently giving the agent's staff, enabling the supervisor's own staff to see what instructions he is issuing.

A defect of the system is that it is not possible to send out more that two copies of each note, and the third copy remaining in the book may get faint and difficult to read if the carbons are allowed to deteriorate.

For more lengthy notes to the contractor, or where more than two copies must be sent out (eg two for the agent and a third copy for the inspector), typed notes may be necessary, and they should be headed "Memo to Agent" rather than be put on official notepaper. It seems out of place to use officially headed paper for notes to the agent or his staff or for 1ninor complaints.

Thus a note which reads:
Concrete blinding. The concrete blinding layer appears too thin in places, so that it is breaking up under traffic before the foundation concrete is laid and the clay is coming through. Could you please see that it is not less than the specified 75 mm thickness, or let me know what the trouble is.

Note:
It is far more acceptable to the agent if sent as a handwritten note or "memo" than as a formal letter of complaint.

9.2.3 Quantity records

The measuring up of quantities will be one of the more important tasks of the resident engineer and his staff. Many techniques of measurement may be employed, but the main essential for them all is to comply with the following two simple rules:

- It should be possible to ascertain immediately from the records what has been measured and what has not.
- The records must clearly show what has been paid for, as distinct from what has been measured. If this is not clear from the start, then endless confusion will result.

Thus to give an instance, suppose there is a large item for an "excavation backfill" in the contract. A contractor may have done a substantial amount of excavation, say 500 m^3 but little or no backfill to date.

The measured amount of 500 m^3 might be put in the quantities record, but for the purpose of payment, the resident engineer and contractor may agree upon an arbitrary figure of 300 m^3 for payment, having regard to the fact that backfill has not been carried out.

The records must therefore show 500 m^3 so far measured and 300 m^3 so far paid for.

The records should therefore be divided on lines which are suggested as follows:

- A series of notebooks containing sketches and dimensions of work as executed where different from the contract drawings.
- A book or file containing the working out of the quantities.
- A summary of the quantities from time to time worked out, all classified under bill items.
- A final summary of quantities agreed for the payment on each certificate.

The first records for quantities mentioned above will be in field notebooks and the date will be recorded in these from time to time as the work proceeds.

These data will be collected by various inspectors and assistants to the resident engineer acting in collaboration with the contractor's quantity surveyor or measurement engineer so that the measurement are agreed on site.

Accuracy, clarity and sufficiency of measurements are essential. As the monthly date for measurement of quantities approaches, the inspectors and staff will bring their measurement notebooks up to date and ready for use in the calculation of quantities.

The items of the bill will be gone through in order and the necessary calculations undertaken to find out the amount of work done during the month under each item.

9.2.4 Comparison of measured quantities with contractor's claim

Having calculated the quantities, they must now be compared item by item with the quantities claimed by the contractor in his monthly claim.

The monthly claim form from the contractor should be presented in the form shown below. The comparison required is between the contractors' quantities under the heading "total to date" and the resident engineer's own calculations. Where differences are found, conversations with the contractor's site staff will be necessary.

SECTION 3 - TANKS		CLAIM FORM							
Item No	Description	As Bill		As Measured		As Bill		Amount	
		Quantity	Unit	Last Certificate	Since Last Certificate	Total to Date	Rate	R	C
418	EXCAVATION Stripping soil	483	m²	990	-	990			
419	Excavation for tower	503	m³	503	-	503			
420	General excavation	836	m³	400	428	828			
421	12 by hand	72	m³	-	74	74			
422	12 by trench	2	m³	-	2	2			
423	Soiling and sowing on flat	210	m³	-	-	-			
424	Soiling and sowing on slopes	176	m³	-	-	-			
425	Excavation for base of ladder		m³	-	-	-			
						TOTAL FOR EXCAVATION			
426	MASS CONCRETE Blinding 3, etc.	17½	m³	10	6	16			

Figure 9.1

SECTION 3 – TANKS – EXTRA BILL ITEMS									
Item No	Description	Comparable Bill Item	Unit	As measured				Amount	
				Last Certificate	Since Last Certificate	Total to Date	Agreed Rate	R	C
422A	Extra excavation by hand below trench	422	m²	-	5	5			
426A	Class E mass concrete	426	m³	-	11	11			

Figure 9.2

It may be that quantities put forward by the contractor are less than quantities measured by the engineer or, as previously mentioned, they may be arbitrary figures used for payment purposes only.

Note:
For bulk excavation which has only been partly completed, it is a waste of time trying to compute accurately the quantity excavated to any given day.

The quantity as finally excavated - to the underside of the foundations and so on - is the figure that must be exact, and these calculations need only be undertaken when foundation excavations are completed.

Hence, in the meantime, the resident engineer and agent (or their respective staffs) may agree on a "round figure" representing the approximate excavation

to date. This is simply a temporary arrangement to save unnecessary calculation work before the final quantity must be agreed in detail.

The method is quite satisfactory. It means that the claim form will show a figure under "Total to Date", whereas in the resident engineer's quantity calculation files there will be no quantity, or perhaps only a rough pencil note showing an approximate calculation which is marked "provisional".

9.2.5 Authorisation and measurement of extra works

The Standard General Conditions of Contract for work states that extra or varied works must be authorised in writing by the engineer. The same clause permits a verbal order to be given provided that this is later confirmed in writing, either by the engineer sending some authorisation to the contractor, or by the contractor sending a letter of confirmation to the engineer.

Note:
It is frequently impossible for the engineer to send a written variation order to the contractor in advance of the variation being undertaken.

What happens is that agreement is reached between agent and resident engineer on the site to the effect that a certain matter "shall be recovered by a variation order", and it is then up to the resident engineer to submit a draft order to the engineer for his signature.

A typical variation order issued is shown in **Figure 9.3**.

VARIATION ORDER

No .....

JOB .....

CONTRACT No ..... DESCRIPTION .....

CONTRACTOR .....

In accordance with, and subject to the Conditions of Contract, you are hereby instructed to execute the following work:

The prices to be allowed for the above work shall be:

This work is additional to/substituted for work hitherto included to the Contract.
You are instructed to omit items of work as follows:

ESTIMATED NET EFFECT ON THE COST OF WORKS

This Variation Order ..... increase/decrease

Add total effect of previous
Variation Order issued ..... increase/decrease

TOTAL ESTIMATED EFFECT increase/decrease

Signed ..... Signed .....
Resident Engineer Engineer

Date ../../.... Date ../../....

Figure 9.3

Normally the resident engineer and agent would hope to come to an agreement as to the price paid for the extra or varied works, before the draft order is submitted to the engineer for signature. This price is either an agreed rate for payment by measurement, or day work.

Definition: Day work
"Day work" is a term meaning "by the day" - or, in this particular context - reimbursement to the contractor according to the cost of labour, plant and materials actually engaged on the varied work, charged at daily or hourly rates.

The Prices to be paid for day work may be as set out in a schedule attached to the contractor's tender; or they may be the prices as set out in the current edition of "Schedules of Day-works Carried out Incidental to Contract Work" issued by The Federation of Civil Engineering Contractors.

DAYWORKS CLAIM SHEET

..... Contractors Ltd

JOB .....Date: ../../....

CONTRACT No .....

Variation Order No .....

(Cutting hole in gable end for service pipe, temporarily plugging and forming cut-off wall)

DAYWORKS ACCOUNT

Dates carried out: 16 th – 24 th December

Quantity	Unit	Item	Rate	R	c
75	Number	Bricks (per 1 000)			
1	m^3	Sand (per m^3)			
½	m^3	Cement (per pocket)			
25	Hours	Compressor			
56	Hours	Labourers			
17	Hours	Bricklayer			
		Add 10%			
		TOTAL			

Signed ..... Signed .....

Contracctor Resident Engineer

Figure 9.4 Dayworks claim sheet

This type of sheet is submitted by the contractor to the resident engineer for checking materials used and time spent. After signing by the resident engineer it is returned to the contractor for resubmission in his monthly claim for payment.

Alternatively the time sheets of the men on the work and the material sheets for material used may be presented daily by the contractor for signature by the resident engineer, the full account being made up later.

The typical daywork schedule contains these parts which provide for reimbursement to the contractor on the basis of:

- The cost of labour plus a percentage foe overheads.
- The cost of all materials used plus a percentage for handling, etc.
- The cost of plant at certain rates for each type of plant.

From this it follows that as soon as the resident engineer has authorised some extra works to be carried out on a daywork basis, he must arrange that the labour; materials and plant used to carry out the extra work are observed and checked by his staff - usually by his inspectors.

It is normal practice to expect the contractor's foreman to submit daily time and materials sheets to the inspector for him to check and sign to the effect that they are correct as to hours worked, as well as to materials and plant used.

Later it must be the task of an engineer on the resident engineer's staff to check the "daywork claims" as they come in from the contractor. A typical daywork claim sheet is shown **Figure 9.4**.

Definitions

Dayworks is work carried out for payment, based on actual hours worked and material used, plus an agreed profit.
Omissions are items of work deleted from the bill of quantities by a variation order.
Variation is an authorised alteration from the original drawings specification.
Extras is work additional to that provide for in the contract.

9.2.6 Dayworks

On all contracts, circumstances can be encountered during the progress of the work where an operation involves work that cannot be measured or adequately measured and adjusted against a measured valuation.

Work of such a nature can be reimbursed to the contractor on a daywork basis only.

Note:
Daywork consists of the nett cost of materials and labour necessary to complete the items of work, plus a percentage to cover the contractor's establishment charges and profit.

All items of daywork should be set out on record sheets showing labour, time and cost, together with materials and plant cost. These sheets should be prepared regularly and passed to the Clerk of Works each week for him to check and certify correct.

He should be able to check items of agreed daywork from his own record. The method of submission of daywork sheets is important, for It is essential that these should be submitted not later than the week in which the work was carried out, otherwise the costs involved will be difficult to control, in that the conditions surrounding the work, as well as the evidence supporting such claims, may no longer be in existence.

The clerk of works would be entitled to decline to certify or sign sheets left for a number of weeks before being requested to do so.

Example

The architect may, in his opinion, if it is necessary or desirable, order in writing that any additional work shall be executed on a daywork basis.

The contractor shall then be paid for such work under the conditions set out in the daywork schedule included and at the rates and prices affixed thereto by him in his tender, and failing the provision of a daywork schedule, he shall be paid the actual cost to the contractor of the wages expended and the materials used in the additional or substituted work, plus the percentage allowances stated in the appendix to the form of tender in respect of:

- the net disbursements in wages to the workmen actually engaged, and
- the net cost of materials actually used in the completed work, which allowances will be held to cover all charges for the contractor's and sub-contractor's profits, timekeeping, clerical work, insurance, establishment superintendence other than allocated foremen's time, and the use of hand tools.

If the contractor fails to fill in the percentage daywork allowances in the appendix to the form of tender, those stated therein by the owner shall apply.

The use of plant shall be charged out separately on a time basis at the rate tendered or otherwise at rates to be agreed by the contractor and the architect.

If the architect's representative or by the architect, the contractor shall furnish to him such receipts or other vouchers as may be necessary to prove the amounts paid, and before ordering materials shall submit to the clerk of works or to the architect quotations for the same for his approval.

In respect of all work executed on a daywork basis the contractor shall during the continuance of such work, deliver each day to the clerk of works or to the architect, an exact list in triplicate of the occupation and time of all workmen employed on such work and a statement also in triplicate, showing the description and quantity of all materials and plant used thereon or therefore (other than plant which is addition in accordance with the schedule under which payment for daywork is made).

Duplicate copies of each list and statement will, if correct or when agreed, be signed by the clerk of works or architect and returned to the contractor.

At the end of each month the contractor shall deliver to the clerk of works or to the architect a priced statement of the labour, materials and plant (except as aforesaid) used and the contractor shall not be entitled to any payment unless such statement has been fully and punctually rendered and supported by the aforesaid countersigned lists and statements.

9.2.7 Variation

Variation orders is an instruction which involves a variation in cost or which may affect the contract period within which the work is to be completed. It should establish the facts quite clearly at the time it is issued to obviate it being left to be argued about at the end of the contract.

An extension of the contract period can necessitate extensions of their respective insurances to the contractors on the site.

Note:
Instructions from the architect or clerk of works should initially be issued to the supervisor in writing via the site instruction book and to the contractor's main office by variation order or letter.

In the event of the instruction being verbal and not confirmed on site, the supervisor should notify his head office who, in turn, will confirm it to the architect in writing.

An official variation order should incorporate, where possible the appropriate reference to the items in the bill of quantities, so that the work involved can be measured accurately as it proceeds.

Copies of the variation order must be issued to the client, contractor, quantity surveyor, clerk of works and the supervisor, so that their records can all be kept accurate and complete.

The supervisor could to advantage pick up, verify and otherwise comment, on variations received in either his diary or site reports.

While he can, with perfect justification, assume that the instructions issued to him have been considered in the light of all implications, he would nevertheless be wise to check and satisfy himself that a variation order received has nothing in it which conflicts with by-laws, legislation concerning building, the drawings or other documents, and if found, in fact, to require revision or clarification, raised the matter with both his employer and the architect or clerk of works before the work is commenced.

Variation orders should be received in time to permit this and not, as so often happens, after it has been done.

Nevertheless, the practice of introducing alterations right up to the last few weeks of a contract is to be deprecated, and, if possible, a date should be agreed beyond which no instructions must be given for extras unless the contract period is also extended and the resultant overheads reimbursed.

In order, both that financial adjustments may be settled amicably, and drains or services, etc be recorded "as built" for future reference, it is imperative that all changes should be methodically agreed and measured.

Note:
Original and final site levels, extra depth of excavation or concrete, and all additional construction details must be placed on record drawings and submitted for signature.

Works not immediately measurable should be recorded in daywork sheets on a time and material basis, in accordance with a mutually agreed procedure.

When variations of price records (see **Figure 9.5**) are required, these should be kept right up-to-date and presented for regular inspection.

If grounds for claims arise, then these should be notified in writing as quickly as circumstances allow, so that they may be discussed and, if possible, settled at the next site meeting.

The prompt adjustment of variations is advantageous to all parties, and promotes that friendly co-operation so essential to a successful venture.

MATERIALS: RISE AND FALL								
Invoice		Supplier	Details	Quantity	Price	Cost	Basic value	Increased cost
Date	No							
12/6	43	G. Sales	Sand	50m³	R20-00	R1 000	R15-00	R5-00

Figure 9.5

9.2.8 Extras

The contractor is not bound to do anything outside the terms of the contract; also, the contractor cannot recover charges for work not included in the terms of the contract. If additional work is required a fresh contract should be made.

Should a contractor be instructed by an architect to do work not specified in the contract, he should seek confirmation from the owner or client, as otherwise not only he be unable to recover his charges, but he may be held liable for damages.

All extras or variations must be ordered in writing and certified by the architect. The basis of payment for extras should be set out in the contract, usually in a schedule thereto, otherwise the law will imply reasonable payment therefore.

Note:
The contractor should be protected by a clause in the contract allowing additional time for carrying out extras.

The contractor should send to the architect or owner once a month an account giving full and detailed particulars of all claims for any additional expense to which the contractor may consider himself entitled and of all extra or additional work ordered by the architect or client which he has executed during the preceding month, and no claim for any such work will be considered which has not been included in such particulars.

Provided that the client or architect shall always be entitled to authorise payment to be made for any such work, not-withstanding the contractor's failure to comply with the conditions of the contract, and provided further that the contractor has at the earliest practicable opportunity notified the client or architect that he intends making claim for such work.

In a bill of quantities we often find the term "extra over". This term extra over, or additional cost is made up of:

- The additional cost of the materials over and above the cost of the ordinary, eg the cost of facing bricks over and above the cost of the ordinary bricks.
- Any additional labour cost involved in selecting or hand picking the materials, eg hand picking of facing bricks.
- The additional artisan and labourer hours taken, eg laying face bricks in the work as compared with ordinary brickwork.

The method of working out this "extra over" cost may be worked out on a basis of one or other of the following:

- per square metre of facing work;
- per one thousand facing bricks.

Extra item in the contractor's monthly claims

When the contractor's monthly claim is submitted, it will probably contain not only the measurement of quantities as set out in the original bill, but:

- extra items at agreed rates, and
- accounts for dayworks

Some engineers do not insist that all extra items be covered by variations orders when, for instance, there are items in the original bill for trench excavation at 600 mm depth and 900 mm depth and an extra item is added for excavation at 1, 2 m depth.

This extra items is sometimes inserted in the bill as an "A" item, without any variation order being issued. But this is confusing, and the best method is to ensure that variation orders are given to cover all variations.

It is then best for the contractor to list all the extra or varied items at the end of his claim, in the same order as the variation orders are numbered because this is the order in which the bill of quantities has been extended, and it makes for ease of checking.

There is, however, one difficulty that must now be discussed, namely, where a variation order covers extra work which is still measurable at bill rates. This frequently happens. For instance, the engineer might order the contractor to undertake more excavation work, at rates which are already in the bill of quantities.

Initially, it is for the engineer to decide whether this is an occasion on which to issue a variation order. If he decides that no variation order need be issued then this results in the measurement exceeding the quantity provided in the bill of quantities against certain particular items.

If he decides, on the other hand, that a variation order ought to be issued, then if the bill rates apply, the variation order should say so, quoting the items of the bill likely to suffer extended measure as a result.

Note:
A tender may have a price variations clause attached to it and be accepted on that basis. Under such a clause the contractor is reimbursed also for the cost of extra wages that he has to pay because of increases in nationally agreed rates of wages, and the extra cost as a result of increased prices of materials.

A contract containing such a clause puts a heavy added accounting burden upon the resident engineer and his staff.

To deal with wage increases, it is first up to the contractor to submit claim sheets for the extra due. These claim sheets will be complicated and probably lengthy calculations based upon the weekly pay sheets.

Thus, if there has been a 10c per hour increase on the basic wage rate then the substance of the claim will amount to the total number of man-hour shown on any given pay sheet multiplied by 10c.

There are, however, some rather unpleasant complications to be taken into consideration which may be listed as follows:

- The increases apply to overtime rates as well.
- Building operators may get different rises on different rises from the civil engineering workers.
- The plus rates for skill or conditions of working conditions (ie additions above the basic rate for the many workers who are not just labourers working under normal conditions) may also be varied.
- The subsistence or lodging allowances may be altered.

- The employer's portion of the national health and insurance contributions may be altered, and so may the holidays-with-pay contributions.

The just payment to the contractor for extra works on dayworks is the actual cost of labour and materials at the time the work is carried out, plus the agreed percentage then prevailing, plus the agreed hire rates for plant also current.

The extra works cannot be fairly worked out on the basic prices in the bill, will the increases to wages and cost of materials paid for separately.

this case the contractor would lose the percentage he is entitled on the increases of wages and materials.

Actual prices and rates of wages must therefore be used for extra work charges, and it is thus important that the resident engineer's records show the dates on which the work was carried out, so that the prices and wages ruling at that time may be checked against the claims.

It follows that in working out the extra payments due on account of wage increases, the hours spent on daywork must first be deducted.

This complicates the calculations, especially when wage increases are stepped up from time to time, as one must then ensure that the relevant deductions of hours on dayworks must relate to the right time periods between successive increases in wage rates.

However, the job must be tackled because the amounts of money involved may be substantial when the contract extends over a lengthy period.

Where further evidence is required, the resident engineer may call upon the contractor for proof of his claim. He will need to check back through the contractor’s week weekly pay sheets to the time sheets. A kind of elementary auditing is required, but it calls for no special accounting skill.

Evidence must be looked for to see that the men did actually receive and sign for the amount of money that the pay sheets states was paid out to them. The number of men paid should tally with the resident engineer's records for any week.

Circumstances will guide the resident engineer as to the extend of the check he should make. He may choose to check only certain weeks in detail, and if these appear correct and the total claim reasonable, then he may pass the claim for payment.

Any contractor of standing will readily agree to furnish the necessary information, and such a degree of co-operation usually means that nothing other than small errors in accounting are found here and there.

Activity 9.1

1. What are the different methods of a) ordering b) storage c) control and d) issue?
2. What is the crediting of materials?

Self-Check

I am able to:	**Yes**	**No**
• Describe the various methods of:		
o Ordering		
o Storage		
o Control		
o Issue		
• Crediting of materials		

If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.

Module 10

Site Meetings

Learning Outcomes
On the completion of this module the student must be able to:

- Give the reasons for the necessity of site meetings
- Explain the procedure during the handling of a contract
- Describe the typical items for discussion at site meetings
- Record instructions issued at meetings

10.1 Introduction

Site meetings held at the start of a contract, and thereafter regularly each month, or as required during the progress of the work, are highly desirable, and should be initiated by the contractor if neglected by the architect.

Well-organised site meetings maintain the impetus of the job, help to avoid delays, and can resolve differences before they generate friction and lead to misunderstanding.

Note:
Meetings should be conducted in a formal manner in accordance with good committee practice, with an agenda sent out beforehand and minutes (including an "action" column) circulated afterwards.

A permanent chairman and secretary may be chosen by agreement between the architect and the general contractor, but other members should be restricted to those actually concerned at the particular stage and must be responsible representatives authorised to take decisions.

Any procedure for meetings should include the following:

- A list of persons present.
- The acceptance of previous minutes.
- Matters arising from the minutes.
- Progress of the works and causes of any delays.
- Labour, plant or material shortages.
- Outstanding information.

- A review of nominated sub-contractors and suppliers .
- Variations and/or claims for extra.
- Any other business and the date of the next meeting.

Note:
In order to co-ordinate the work on site at the various stages, it is essential to have formal site meetings regularly once work has been commenced.

Meetings may be convened by the architect or the contractor with those presented, then being: the architect, (as chairman), the clerk of works (as alternative secretary), the consulting engineer and other consultants, contractor, contracts manager, general foreman, and sub-contractors, as and when their work effects the main contract.

These should take place at regular intervals, depending on their needs which, as a rule, is fortnightly or monthly. They constitute the most satisfactory manner in which to solve difficult contractual or site matters.

Queries can be raised, causes of delays thrashed out, thereby eliminating much unnecessary correspondence. Sub-contractors can state their requirements, and the architect's drawings perhaps not received yet, be requested in time to avoid delay.

Note:
Prior discussion between contractor and architect with a view to the establishing of an agenda will at times be necessary.

Decisions arrived at and minuted will serve as instructions. The minutes typed and signed by the chairman of the meeting are circulated to all the parties involved in the contract, so that that their records can be kept accurate and complete as the works proceeds.

Weekly meetings of site supervisory, technical and senior clerical staff, together with chosen sub-contractors, under the chairmanship of the agent; are an excellent way of exercising control.

Progress can be related to the programme shortages discussed and means of overcoming then decided, and anticipated problems settled, or by-passed such a meeting every Friday, to review the past week and survey the week ahead, can do much to lubricate the organisational machinery and weld the individual, functions into a synchronised machine.

This semi-informal meeting is only one step away from the conscious purpose of short-term planning.

Site reports to the architect's office may be required weekly from the general foreman when there is no clerk of works on site, and a copy of this may also suffice to keep the contractor's head office aware of general progress and necessary action.

Otherwise, a daily or weekly report should be submitted in order that the pulse of the job may be watched and any assistance provided.

A report should include the following information:
- Labour strength, including sub-contractors.
- Labour plant, material, information.
- Sub-contractor shortages.
- Delays incurred with causes, eg weather, breakdowns, visitors, instructions received.

Works progress may be advised by means of a shuttle copy of a programme chart or by a statement of percentages for each operation.

Activity 10.1

1. What are the reasons that make site meetings a necessary part of a building project?
2. What are the procedures during the handling of a contract?
3. What items are typically discussed at site meetings?
4. Why is it necessary to record instructions issued at site meetings?

Self-Check

I am able to:	Yes	No
• Give the reasons for the necessity of site meetings		
• Explain the procedure during the handling of a contract		
• Describe the typical items for discussion at site meetings		
• Record instructions issued at meetings		

If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.

Past Examination Papers

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

APRIL 2013

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N5

(**4090045**)

25 March 2013 (X-Paper)
09:00 – 12:00

This question paper consists of 7 pages.

TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Answer in full sentences where applicable and in your own words. Incomplete, cryptic phrases will be penalized.
5. Write neatly and legibly

QUESTION 1

1.1 A few paragraphs on the general foreman regarding some of his/her qualification, personal characters and duties are given below.

Complete the following sentences/paragraphs by filling in the missing word(s). Write only the words next to the question number (1.1-1.1 0) in the ANSWER BOOK.

Depending on the size of the project, the general foreman should be a fully qualified (1.1) ... or should have a technical diploma/degree in construction management or similar qualification.
He/she must be able to work under extreme pressure and must be able to identify and solve (1.2) . . . . He/She should be flexible, practical and helpful.
Although he/she must (1.3) ... work to various trade foreman, the storekeeper subcontractors and others, the ultimate (1.4) ... for the smooth running of the project lies with him/her.
He/she must see to it that all activities run according to the master (1.5) ... , that all labour is utilized and that the required equipment and material is always available,
various trade teams and sub-contractors have to be (1.6) ... to ensure smooth interaction.
It is his/her duty to make sure that construction is carried out according to the contract (1.7) ... , that the architect's site instruction are incorporated and that (1.8) ... for any changes are issued and authorized.
He/she is responsible for all (1.9) ... precautions, that means he/she has to check for example if hard hats are worn.
He/she must maintain a neat site office, and has to keep the drawing register and progress (1.1 0) ... up to date.

(10 x 1) **[10]**

QUESTION 2

Give ONE word/term for each of the following quality requirements by choosing a word/term from the list below. Write only the word/term next to the question number (2.1-2.1 0) in the ANSWER BOOK.

water; bricks; structural timber; cement; stone; ceramic sanitary fittings; steel frames; glass pane; sand; hardcore filling; reinforcing steel; iron mongery; ready mixed concrete; paint; PVC pipes; putty

2.1 It should be prime coated and should be stacked vertically to prevent twisting and for easy access.

2.2 It should be free of knots and each member must be a continuous length without laps.

2.3 It should give a clear (not hollow) sound when lightly knocked with a metallic object such as a screw driver.

2.4 When packed in sacks and store under good condition, it is expected to lose its strength slowly.

2.5 Its workability is tested by slump test.

2.6 It should clear (not hollow) sound when two of its kind are knocked against each other.

2.7 It should consist of well graded and smooth rounded particles.

2.8 It should consist of single size and smooth rounded particles.

2.9 If not immediately used, it should be spread out on a site across poles with colour tags for easy identification.

2.10 If it is taken from municipal source, it can be accepted as suitable.

(10 x 1) **[10]**

QUESTION 3

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write 'true' or 'false' next to the question number (3.1 - 3.10) in the ANSWER BOOK. Correct the statement if it is FALSE.

3.1 3.1 Variation orders could be savings or extras.

3.2 Variation orders are site instructions.

3.3 Additions are variations orders.

3.4 Extensions of time are calculated by day works.

3.5 Day works are day to day happenings on site

3.6 Day works are all works above the natural ground level.

3.7 The contingency sum provides money for extras.

3.8 One speaks of day work as if it is the measured labour and material per day.

3.9 Variation orders are issued by the clerks of works.

3.10 Omissions are savings.

(10 x 1) **[10]**

QUESTION 4

4.1 List FIVE different earthwork categories in which mechanical plant may be grouped with ONE type Of mechanical plant in each of the categories. (5)

4.2 Explain the following in modern road construction:

4.2.1 THREE advantages of mechanisation. (3)

4.2.2 TWO advantages of labour intensive methods. (2)

[10]

QUESTION 5

In the principal building agreement (basic contract) a number of clauses regulate the handing over of completed work. Describe the following key terms used in these clauses.

5.1 Final completion list

5.2 Certificate of final completion

5.3 Final account

5.4 Final payment certificate

5.5 Patent defect liability period

5.6 Latent defect liability

5.7 Liability insurance

5.8 Release of the retention or release of the construction guarantee

5.9 Penalty for non-completion

5.10 Extension of construction period

(10 x 1) **[10]**

QUESTION 6

Fully explain how the following is incorporated in a building contract:

6.1 Nominated sub-contractors. (5)

6.2 Selected sub-contractors. (5)

[10]

QUESTION 7

Define the role played by the following people or professionals in constructions site:

7.1 Agent

7.2 Architect

7.3 Engineer

7.4 Office manager

7.5 Building control officer

(5 x 2) **[10]**

QUESTION 8

8.1 What is meant by:

8.1.1 Planning (1)

8.1.2 Programming (1)

8.1.3 Progress (on a programme) (1)

8.1.4 Administration (1)

8.2.1 Name THREE types of detail programmes. (2)

8.2.2 Why are they used? (1)

8.2.3 Where are they used? (1)

8.2.4 How are they used? (1)

[10]

QUESTION 9

Prepare a complete agenda for the contractor's site meeting where you will be the chairperson.

[10]

QUESTION 10

10.1 Draw a mass-haul diagram using the tabulated figures below:

CHAINAGE	CROSS-SECTIONAL AREA IN m^2
0	0
100	1000
200	2500
300	800
400	0
500	-1600
600	-3200
700	-400
800	-1800
900	0
1000	1300
1100	3600
1200	4000
1300	2000
1400	0
1500	-1800
1600	-3600
1700	-1600
1800	0

(6)

10.2 Show the following features to the mass diagram:

10.2.1 Cut (1)

10.2.2 Fill (1)

10.2.3 Balance points (1)

10.2.4 Direction of haul (1)

[10]

TOTAL: 100

Marking Guidelines

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

APRIL 2013

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N5

(4090045)

This marking guideline consists of 6 pages

QUESTION 1

1.1 Technician

1.2 Problems

1.3 Distributed

1.4

1.5 Programming

1.6 Co-ordinated

1.7 Documents

1.8 Variations

1.9 Safety

1.10 Report

(10 x 1) **[10]**

QUESTION 2

2.1 Steel frame

2.2 Structural timber

2.3 Ceramic sanitary fittings

2.4 Cement

2.5 Ready mix concrete

2.6 Bricks

2.7 Sands

2.8 Stone

2.9 Reinforcing steel

2.10 Stone

(10 x 1) **[10]**

QUESTION 3

3.1 TRUE

3.2 TRUE

3.3 TRUE

3.4 FALSE

3.5 TRUE

3.6 TRUE

3.7 TRUE

3.8 FALSE

3.9 FALSE

3.10 FALSE

(10 x 1) **[10]**

QUESTION 4

4.1
- Levelling : dozer, grader, scraper etc
- Excavation : back actor, dragline, trencher etc
- Loading :tractor, shovel, face shovel etc
- Compacting : rollers, vibrators
- Transport : lorries, trucks (5)

4.2.1 Less crime in the country
Better control
Less motivation necessary
Better planning possible (3)

4.2.2 Less crime in the country
Work creation
Better work relations
No maintenance/replacement cost (2)

[10]

QUESTION 5

5.1 Final completion list
The list issued by the architect with the certificate of practical completion

(hand over) of work items to be completed or rectified to enable the architect issue the certificate of final completion

5.2 Certificate of final completion
The final document which the architect issues to confirm that the contractor is realized of his obligations to the employer.

5.3 Final account
The revised tender price which is usually only finalized after handing over

5.4 Final payment certificate
The certifying of the last payment which only happens some time after handing over

5.5 Patent defect liability period
The period after practical completion (after handing over) where in the contractor has to repair all defects.

5.6 Latent defect liability
Some errors can only be detected after a certain time, eg leaking roof.
A clause keep the contractor a while responsible (5 yrs after the commencement of work) after handing over to repair it.

5.7 Liability insurance
The responsibility to ensure the building and people shifts immediately with handing back from the contractor to the employer.

5.8 Realize of retention or realise of construction guarantee.
When all defects are repaired, the contractors guarantee lapses.

5.9 Penalty for non-completion
An amount of money which the contractor has to pay per day to the employer in case he cannot hand-over the works within the tendered period.

5.10 Extension of construction period
If the tendered period (because of the reasons which the contractor cannot control) is expected by the architect by means of variation order.

(10 x 1) **[10]**

QUESTION 6

6.1 Nominated sub-contractors (5)

Nominated sub-contractors.

Appointment	: by architect by main contractor is party in contract
Recognition	: by architect and main contractor communication through general foreman
Liability	: site meetings : non-sub contractors is liable to employer
Attendance	: as per contract : Main contractor has to give attendance
Payment	: such as assistance, water supply etc : certified by architect : via main contractor :provisional sum

6.2 Selected sub-contractors (5)

[10]

QUESTION 7

Define the role played by the following people or professionals in constructions site:

7.1 Agent

7.2 Architect

7.3 Engineer

7.4 Office manager

7.5 Building control officer

(5 x 2) **[10]**

QUESTION 8

8.1 What is meant by:

8.1.1 Planning (1)

8.1.2 Programming (1)

8.1.3 Progress (on a programme) (1)

8.1.4 Administration (1)

8.2.1 Name THREE types of detail programmes. (2)

8.2.2 Why are they used? (1)

8.2.3 Where are they used? (1)

8.2.4 How are they used? (1)

[10]

QUESTION 9

Prepare a complete agenda for the contractor's site meeting where you will be the chairperson.

[10]

QUESTION 10

10.1 Draw a mass-haul diagram using the tabulated figures below: (6)

10.2.1 Cut (1)

10.2.2 Fill (1)

10.2.3 Balance points (1)

10.2.4 Direction of haul (1)

[10]

TOTAL: 100

Past Examination Papers

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NOVEMBER 2012

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N5

(**4090045**)

14 November 2012 (X-Paper)
09:00 – 12:00

This question paper consists of 6 pages.

QUESTION 1

Complete the following paragraphs on the handling of building material by filling in the missing word(s) or phrase. Write only the missing word(s) or phrase next to the question number (1.1 - 1.1 0) in the ANSWER BOOK.

When materials are needed on site, the general foreman contacts the (1.1 ...) department of the head office to order them from the suppliers. As soon as the materials arrive on site the foreman will check their quantity and quality and will sign the (1.2 ...). At the storing areas and sheds the (1.3 ...) has to keep records of all
materials which are received or dispensed.

At present in South Africa a number of security measures have to be taken as (1.4 ...) has become a real problem. Another big problem is the (1.5 ...) of the materials, which means that they are not handled properly and that off-cut and leftovers are left lying around, get damaged or are thrown away.

Bulk materials such as sand, crushed stone and bricks should be off-loaded and stored as near as possible to the (1.6 ...). Timber, cement in sacks and other materials that are easily damaged by (1.7 ...) must be kept under shelter. Chemicals like paint and acid which (1.8 ...) must be securely locked away. Sanitary fittings and glass
panes should be stored on racks with enough space in between, because (1.9 ...).
Iron monger, taps and other small items have to arrive as late as possible on site and only fixed at the latest stage possible, because of (1.1 0 ...).

[10]

QUESTION 2

A few paragraphs regarding variation orders are given below. Write only the missing word next to the question number (2.1 - 2.1 0} in the ANSWER BOOK.

A clause in the principal building agreement makes provision for (2.1 ...) which are any deviations from the original drawings or specifications.

To see whether the deviations fall within the employer's budget, the quantity surveyor prepares (2.2 ...). Deviations which are difficult to price, because items and rates differ from those in the bill of quantities, are evaluated by means of (2.3 ...). Foreseen deviations like plumbing and drainage work are easily re-measured as the items and rates are found in the bills of quantities under the section (2.4 ...).

If the deviation increases the tender price, the employer's additional payments are . (2.5 ...). If certain deviations cause the employer to pay less for certain sections of work as originally planned for, the amounts are called (2.6 ...). If certain deviation causes the builder to do less work as originally planned for

the measurements are called (2.7 ...)? namely (2.8 ...), have to make up the difference.

On the other hand, deviations usually may not turn out to increase the total tender price, for that-purpose a lump sum amount for (2.9 ...) is allowed to limit the contract price. With large contracts, price increases caused by inflation are also deviations and compensation is called (2.1 0 ...).

[10]

QUESTION 3

Give ONE word/term for each of the following descriptions by choosing a word/term from the list below. Write only the word/term next to the question number (3.1 - 3.10) in the ANSWER BOOK.

action column; engineer; agenda; minutes; apologies; motions; attendance register; quorum; chairperson; seconder; closing; secretary; constitution; site manager; executive committee; worker

3.1 A list of business items or activities to be dealt with at a meeting in a specific order

3.2 The report of the resolutions taken at a meeting, but also included an impartial version of the proceedings at a meeting

3.3 A list on which the members present are carefully stipulated

3.4 Points of discussion or proposals which fall under the so-called new business

3.5 The rules by which meetings are governed

3.6 The minimum number of members to be present to be able to take resolutions

3.7 The executive official on whose efficient shoulders the whole administration rests

3.8 The person who ensures that all discussions are relevant and addressed to the chair and that adequate opportunity is given to all members to express their views

3.9 The person who supports a proposal before it can be voted on

3.10 The members who do not take resolutions or make recommendations to the general meeting

[10]

QUESTION 4

4.1 List FIVE different earthwork categories in which mechanical plant may be grouped with ONE type of mechanical plant in each of the categories. (5)

4.2 Explain the following modern road constructions:

4.2.1 THREE advantages of mechanisation (5)

4.2.2 TWO advantages of labour intensive methods (5)

[15]

QUESTION 5

Write TEN explaining aspects on delegation.

HINT: Include a definition. You could write about the importance/advantages, points to be considered and the line of delegation.

[10]

QUESTION 6

6.1 What are the basic functions and intentions of a contract document? (2)

6.2 Name FOUR contract documents and briefly explain how these documents relate to one another. (8)

[10]

QUESTION 7

7.1 Answer the following in table form. Name only ONE party that decides on the appointment and with whom the following conclude a contract:

7.1.1 Main contractor (2)

7.1.2 Selected sub-contractor (2)

7.1.3 3 Nominated sub-contractor (2)

7.2 Fully explain the term attendance. (4)

[10]

QUESTION 8

In the Principal Building Agreement a number of clauses regulate the handing over of the completed works.

Describe, define or explain each of the following key terms used in these clauses:

8.1 Liability insurance

8.2 Latent defects liability

8.3 Patent defects liability period

8.4 Release of the construction guarantee

8.5 Penalty for non-completion

8.6 Extension of construction period

8.7 Final completion list

8.8 Certificate of final completion

8.9 Final accounts

8.10 Final payment certificate

[10]

QUESTION 9

The table below gives the lengths of the ordinates from the edge of a small river to the edge of a straight building. This area has to be paved.

Distance (m)	0	5	10	15	20	25	30	35	40
Ordinate (m)	30	33	30	38	30	18	11	18	20

9.1 Plot the area of the paving. **(2)**

9.2 Use the mid-ordinate method.
A= 1/2d[(01 + 09} + 2(02 + 03 + 04 + 05 + 06 + 07 + 08)]
Calculate the approximate area of paving. **(3)**

9.3 Use Simpson's rule.
A= 1/3d [(01 + 09) + 2(03 + 05 + 07) + 4(02 + 04 + 06 + 08)]
Calculate the approximate area of the paving. **(4)**

9.4 Which of the TWO answers (QUESTION 9.2 or 9.3) would you suggest to be more precise? **(1)**

[10]

QUESTION 10

10.1 Prepare a complete agenda for an architect's third site meeting. Make your own assumptions. **[10]**

TOTAL: 100

Marking Guidelines

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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NOVEMBER 2012

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N5

(4090045)

This marking guideline consists of 9 pages

QUESTION 1

1.1 Buying department

1.2 Delivery invoice

1.3 Storekeeper/store clerk

1.4 Fine and theft

1.5 Care

1.6 Works

1.7 Moisture

1.8 Are toxic

1.9 Fragile

1.10 Damage/theft

[10]

QUESTION 2

2.1 Variations

2.2 Variation account/estimates

2.3 Day work

2.4 Provisional work

2.5 Extras

2.6 Savings

2.7 Omissions

2.8 Seconder

2.9 Executive committee

2.10

[10]

QUESTION 3

3.1 Agenda

3.2 Minutes

3.3 Attendance

3.4 Motions

3.5 Constitution

3.6 Quorum

3.7 Secretary

3.8 Chairperson

3.9 Seconder

3.10 Executive committee

[10]

QUESTION 4

4.1	Leveling	Dozer Grader Scraper
	Excavating	Back actor Dragline Trencher Face shovel
	Loading	Front-end loader/multipurpose Tractor shovel Face shovel Front-end shovel
	Compacting	Rollers Vibrator
	Transporting	Lorries Trucks

(5)

4.2.1 Advantage of mechanisation:
More reliable- no slow strikes, stay away, illness
Better planning possible
Better control

less motivation necessary
Maintenance can be planned (sick leave cannot)
Reduces labour costs
lncreases the speed of construction
Offers are more balanced/predictable price
Can easily be moved from site to site(people have homes & families)
More accurate work
Neater product/more constant output
Human errors are reduced
Dangerous work can be done by machines
Human impossible work can done, e.g. lifting heavy material
Several storey's
No exhaustion (5)

4.2.2 Advantages of labour intensive methods
Copyright reserved
Work creation
less crime in country
Problems of state are attended
Better work relations
less foreign valuate (Less machines are bought)
could be cheaper than machines
No maintenance/replacement cost
Can work more precise than heavy machines
Can more easily adjust to new circumstances (5)

[15]

QUESTION 5

Delegation definition: The conferring of authority and the correlation of authority and responsibility.

The entrustment of responsibility and authority to another and the creation of accountability for performance.

Importance: To find time for more important work.
Delegate simple work to lower skilled workers to save on high wages.
To use each one to full potential
To let workers feel unmissable but part of the organization
Delegate to specialist to get best quality
To give juniors a chance to prove and to improve themselves/delegate to create jobs.

Points to be considered: Authority must be an example
Satisfaction must be an example
Supervise, control, and feed back

Full responsibility cannot be delegated
Let other in team know

Line of delegation	Architect	Clerk of works
	Head office	Foreman
	Foreman	Trade foreman
	Contractor	Sub-contractor

[10]

QUESTION 6

6.1 Contract documents
Written information/guidance, binding for both parties (2)

6.2 Drawings
Specifications
Bills of quantities
Principal building agreement
(Conditions of contract/ schedule of conditions)
Basic = drawing
Specifications supplement drawings
Bills of quantities = extraction of material & labour of drawings and specifications
Agreement explains and refers to above documents, how to be used. (8)

[10]

QUESTION 7

7.1	Decide to appoint	In contact with	
7.1.1	MC Architect	Employer	(2)
7.1.2	SS/C Main contractor	Main contractor	(2)
7.1.3	NS/C Architect	Main contractor	(2)

7.2 Attendance
Main contractor to assist, co-ordinate
Assistance with ordinary equipment, e.g. scaffolding storing place & services (water & electricity)
Clear water in advance
Main contract is paid for attendance by owner
A clause should be in the contract
Special plant which the contractor does not have
Will not be supplied by main contractor (ANY FOUR) (4)

[10]

QUESTION 8

8.1 LIABILITY INSURANCE
The responsibility to ensure the building and people shifts immediately with handing over back from the contractor to the employer.

8.2 LATENT DEFECTS LIABILITY
Some error can only be detected after a certain time, e.g. a leaking roof. A clause keeps the contractor a while responsible (5 years after commencement of the work) after handing over to repair it.

8.3 PATENT DEFECTS LIABILITY PERIOD
The period after practical completion (after handing over) where in the contract has to repair all defects.

8.4 RELEASE OF CONSTRUCTION GUARANTEE
When all defects re repaired, the guarantee with the contractor lapses

8.5 PENALTY FOR NON-COMPLETION
An amount of money which the contractor has to pay a day to the employer in case he cannot hand over the work within the tender period

8.6 EXTENSION OF CONSTRUCTION PRERIOD
If the tender period (because of reason which the contractor cannot control) is extended by the architect by means of variation order.

8.7 FINAL COMPLETION LIST
The list issued by the architect with the certificate of practical completion (handing over) of work items to be completed or rectified to unable the architect to issue the certificate of final completion.

8.8 CERTIFICATE OF FINAL COMPLETION
The final document which the architect issued to confirm that the contractor is released of his obligations to the employer

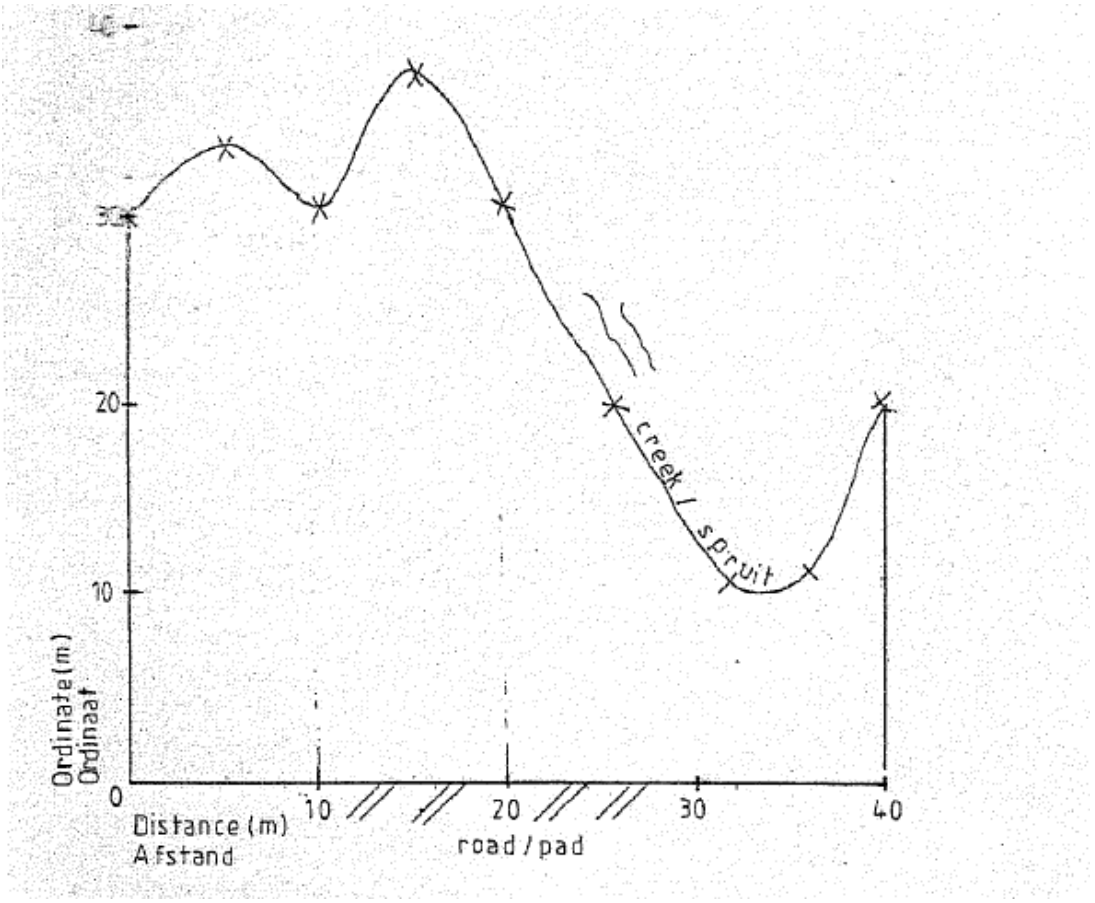
8.9 FINALACCOUNT
The revised tender price which is usually only finalized after handing over

8.10 FINAL PAYMENT CERTIFICATE
The certificate of the last payment which happens some time after handing over.

[10]

QUESTION 9

9.1



(2)

9.2 A = 1 / 2 X 5 [(30 + 20) + 2(33 + 30 + 38 + 30 + 18 + 11 + 18)]
= 1 / 2 X 5 [(50) + 2 (178)]
= 1 / 2 X 5 [50 + 356]
$= \frac{5\ X\ 406}{2}$
= 1015 m^2

(3)

9.3 A = 1 / 3 X 5 [(30 + 20) + 2(30 + 30 + 11) + 4(33 + 38 + 18 + 18)]
= 1 / 3 x 5 [(50) + 2 (71) + 4(107)]
= I / 3 x 5 [50 + 142 + 428]
$= \frac{5\ X\ 620}{3}$
= 1033,33 m^2

(4)

9.4 Give a point for any relevant answer.

(1)

[10]

QUESTION 10

General site meeting not to be held at place at time.

1. Welcome - introduction

2. Apologies for absence
3. Attendance register
4. Minutes
5. Matters arising from minutes
6. Main business
   6.1 General problem areas
   6.2 Variations
   6.3 Progress
   6:4 Sub-contractor
   6;5 Nominated sub-contractor
   6;6 Local authorities
7. General
   7.1
   7.2
   7.3
8. Date for next meeting
9. Closing **[10]**

TOTAL: 100

Past Examination Papers

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

AUGUST 2012

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N5

(**4090045**)

20 July 2012 (X-Paper)
09:00 – 12:00

This question paper consists of 6 pages and 2 annexures.

TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write neatly and legibly.

QUESTION 1

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.1 - 1.1 0) in the ANSWER BOOK.

1.1 Overhaul refers to ground which is moved more than once.

1.2 Excavated earth must be 'borrowed'.

1.3 Undisturbed earth shrinks if excavated.

1.4 Simpson's rules are used to determine irregular areas.

1.5 Surplus soil must be carted away and dumped.

1.6 By using Simpson's rules and by multiplying the answer with an average depth, one can calculate earth volumes which have to be moved.

1.7 Free haul is covered in the bill of quantities under the item 'carting away'.

1.8 Overhaul refers to maintenance of earthmoving plants.

1.9 Overhaul refers to any additional distance earth has to be transported above the basic distance included in the rate agreed on.

1.10 The accumulative mass-haul curve is used for building material.

[10]

QUESTION 2

2.1 Refer to attached ANNEXURE 1 and write down the correct name of each lifting component (2.1.1 - 2.1.5) used by cranes on site. (5)

2.2 Refer to attached ANNEXURE 2 and name the different parts in the basic connections used in scaffolding. Write dawn the answer next to the question number (2.2.1 - 2.2.5) in the ANSWER BOOK. (5)

[10]

QUESTION 3

Give ONE ward/term for each of the following descriptions by choosing a word/term from the list below. Write only the ward/term next to the question number (3.1 - 3.1 0) in the ANSWER BOOK

special plant; selected subcontractor; contractors; nominated subcontractor; recognition; employer; contractor; main contractor; payment;

ordinary supplier; liability; nominated supplier; making good; consultant; ordinary plant; attendance

3.1 The duty and responsibility of the main contractor to compensate for faulty work of subcontractors

3.2 The firm that specialises in a section such as the lift installation and that is appointed by the architect to sign a contract with the main contractor

3.3 The firm that signs a contract with the employer and thus promises to deliver the works at the set cost and dat

3.4 The assistance given to the subcontractor by the main contractor with services such as the use of scaffoldings and water

3.5 The firm that supplies building material to the contractor as decided and ordered by the purchasing department

3.6 The specialist equipment which is not provided by the main contractor

3.7 The fact that the employer only contracts with the main contractor and that the architect does not interfere with the subcontractors

3.8 The firm that is asked by the main contractor to complete part of the main contractor's work

3.9 The firm that delivers certain goods to the site as instructed by the architect

3.10 The achievement of work which is clean and if necessary, repaired to be as good as new and to match the existing work

[10]

QUESTION 4

4.1 Give THREE ways in which effective communication can be achieved on site. (3)

4.2 Name SEVEN important items which you would consider when compiling an agenda. (7)

[10]

QUESTION 5

Name FIVE contract documents and discuss their relatedness with one another. **[10]**

QUESTION 6

Building material should be SANS compliant.

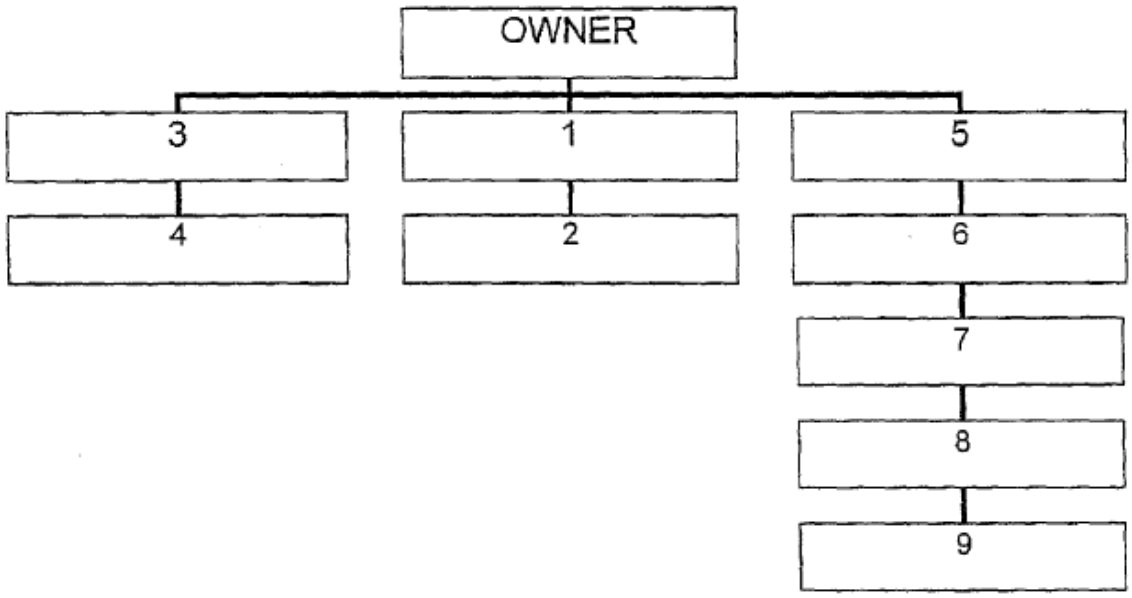
Copy the TABLE below in the ANSWER BOOK. Complete it by filling in the properties for the relevant materials.

Material	Good properties	Bad properties
(1) Concrete		
(2) Cement		
(3) Timber		
(4) Stock bricks		
(5) Stone		

[10]

QUESTION 7

Study the diagram shown below and fill in the missing personnel in the line of authority on a construction project and define ONE duty of each personnel member.



[10]

QUESTION 8

8.1 Name SEVEN purposes of programming in the construction industry. (7)

8.2 Programming is divided into three parts. Name these THREE parts. (3)

[10]

QUESTION 9

9.1 Effective supervision can be identified by three factors. Write down these THREE factors. (3)

9.2 In order to get the work done, the supervisor will need to demonstrate THREE distinct abilities. Name these three abilities. (3)

9.3 Name FOUR main responsibilities of a supervisor on site. (4)

[10]

QUESTION 10

In the principal building agreement a number of clauses regulate the handing over of the completed works. Describe, define or explain the following key terms used in these clauses:

(HINT: Note that some are documents, some refer to periods and others are only terms.)

10.1 Penalty for non-completion

10.2 Patent-defect liability periods

10.3 Latent-defect liability

10.4 Release of the construction guarantee

10.5 5 Extension of the construction period

10.6 Final completion list

10.7 Certificate of final completion

10.8 Final payment certificate

10.9 Liability insurance

10.10 Final account

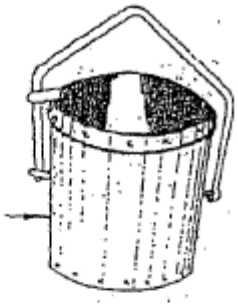
[10]

TOTAL: 100

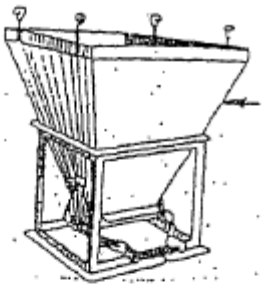
ANNEXURE 1

QUESTION 2.1

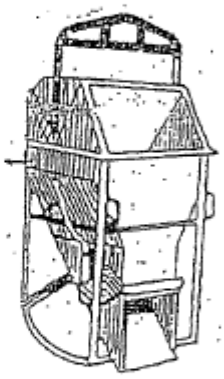
2.1.1



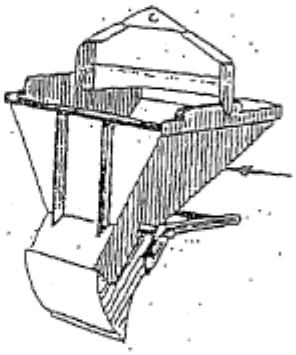
2.1.2



2.1.3



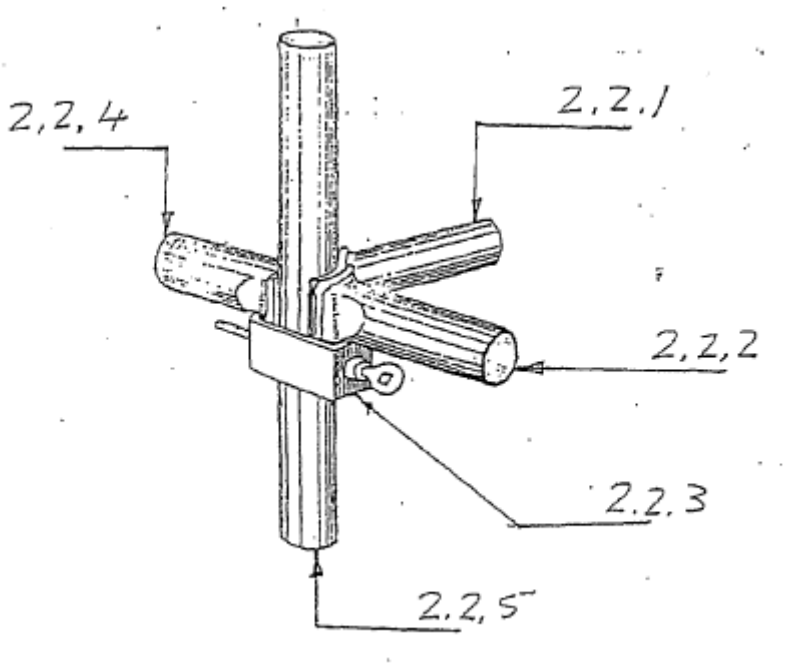
2.1.4



2.1.5

ANNEXURE 2

QUESTION 2.2



Marking Guidelines

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

AUGUST 2012

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N5

(4090045)

This marking guideline consists of 7 pages and 2 annexures

QUESTION 1

1.1 False

1.2 False

1.3 False

1.4 True

1.5 True

1.6 True

1.7 True

1.8 False

1.9 True

1.10 False

[10]

QUESTION 2

2.1 2.1.1 Tipping skip

2.1.2 Bottom discharge skip

2.1.3 Rollover skip

2.1.4 Dumper skip

2.1.5 Crane sling

2.2 2.2.1 Support beam

2.2.2 Scaffold beam

2.2.3 Connection

2.2.4 Scaffold beam

2.2.5 Pedestal

[10]

QUESTION 3

3.1 Liability

3.2 Nominated subcontractors

3.3 Main contractor

3.4 Attendance

3.5 Ordinary supplier

3.6 Special plant

3.7 Recognition

3.8 Selected subcontractors

3.9 Nominated supplier

3.10 Making good

[10]

QUESTION 4

4.1 4.1.1 Conversational talk

4.1.2 File-board system

4.1.3 Sign-board system

(3)

4.2 Agenda of meeting of safety committee

4.2.1 top letterhead

4.2.2 venue

4.2.3 date

4.2.4 time

4.2.5 minutes of the last meeting

4.2.6 matters arising out of these minutes

4.2.7 main business of the day

4.2.8 general

4.2.9 chairman's signature and date

(7)

[10]

QUESTION 5

5.1 Contract drawing: it is pictorial view of the project, where dimensions and levels of the projects are obtained. (2)

5.2 Specification: definition of the required standard of workmanship, where we read quality definitions of fixing each and every material in the works. (2)

5.3 Bills of quantities: quantities of materials are measured with dimensions and levels taken from drawings and quality of material taken from specification. (2)

5.4 Form of tender: it is where the total cost of contract appears and calculated from different quantities of material taken from specification. (2)

5.5 Form of agreement: it is where both parties agreed to each other by signing this agreement:

1. Agreeing on the total cost
2. Owner pays and contractor executes the works (2)

[10]

QUESTION 6

1. Concrete: good properties: plastic state
   Bad properties: honey combed (2)
2. Cement: good properties: uniform fine particles
   Bad properties: rock formation in the bags (2)
3. Timber: Good properties: free of knots
   Bad properties: cup shape, bow shape, honey comb (2)
4. Stock brick: good properties: ring well when struck together
   Bad properties: more water absorption (2)
5. Stone: good properties: same size particles, flaky, elongated
   Bad properties: not uniformly smooth, rounded particles with impurities (2)

[10]

QUESTION 7

Line of Authority
<u>Personnel</u>
1 Architect
2 Clerk of works

3 Quantity surveyor
4 Building surveyor
5 Engineer-
6 Resident-engineer
7 Foreman
8 Artisan
9 Semi-skilled labourers
10 Labourers

Duties

1 Draw plan
2 Work on behalf of architect
3 Prepares bills of quantities
4 Measures the works on site
5 Responsible for stability and durability of the works
6 Check the quality of materials and workmanship
7 Check on the activities on site
8 Specialise in different trades on site
9 Gang leader
1 0 General assistance

[10]

QUESTION 8

8.1 PURPOSE OF PROGRAMMING

8.1.1 To record agreed intentions with the client

8.1.2 To supply a timetable for co-ordinating the issue of drawings and information, the placing of orders and delivery of materials, and the operation of materials, and subcontractors

8.1.3 To prepare the basis for the introduction of payment by result or incentives

8.1.4 To show the sequence of operation and the total output rates required of labour and plant.

8.1.5 To provide a yardstick for progressing and costing.

8.1.6 To furnish the owner with the likely financial requirements

8.1.7 To discourage changes in design by indicating the natural consequences, whilst at the same time facilitating amendments and minimizing their harmful effects should contingencies arise. (7)

8.2 8.2.1 Master or overall programme

8.2.2 Phase or section programme

8.2.3 Short-term programme (3)

[10]

QUESTION 9

9.1 9.1.1 Concern for the task

9.1.2 Concern for the people doing the task

9.1.3 Concern for the co-ordination and the control of the task and the people (3)

9.2 9.2.1 Technical abilities

9.2.2 Administration abilities

9.2.3 Human relations abilities (3)

9.3 9.3.1 Ensure that materials arrive at the right time.

9.3.2 Ensure that the equipment and plant is available at the right time.

9.3.3 Ensure that the work is done in the scheduled time.

9.3.4 Ensure that the work done is to the right quality and standard.

9.3.5 Ensure that good relationships exist.

9.3.6 Ensure that the right men are allocated to the right job.

9.3.7 Ensure that effective communication exists. (any 4 for 4 marks) (4)

[10]

QUESTION 10

10.1 PENALTY FOR NON-COMPLETION: an amount of money which the contractor has to pay per day to the employer in case he cannot hand over the works within the tendered period.

10.2 PATENT-DEFECT LIABILITY PERIOD: the period after practical completion (after handover) wherein the contractor has to repair all defects for 3 months period handing over to repair it.

10.3 LATENT-DEFECT LIABILITY: some errors can only be defected after a certain time, eg leaking of roof. A clause keeps the contractor a while responsible for it (e.g. 5yrs after the commencement of works) after

10.4 RELEASE OF CONSTRUCTION GUARANTEE: when all defects are repaired, the contractors guarantee lapses.

10.5 EXTENSION OF THE CONSTRUCTION PERIOD: if the tendered period (due to reasons beyond the contractor's control) is extended by the Architect by means of a variation order.

10.6 FINAL COMPLETION LIST: the list issued by the architect with the certificate of practical completion (handover) of work item to be completed or rectified to enable the architect to issue the certificate of final completion.

10.7 CERTIFICATE OF FINAL COMPLETION: the final document which the architect issues to confirm that the contractor is released of his obligation to the employer.

10.8 FINAL PAYMENT CERTIFICATE: the certifying of the payment which only happens sometimes after handing over.

10.9 LIABILITY INSURANCE: the responsibility to ensure building and people shift immediately with handing over back from the contractor to the employer.

10.10 FINAL ACCOUNT: the revised tender price which is usually only finalized after handing over.

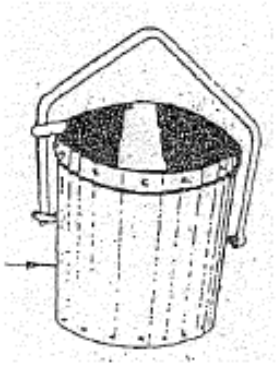
[10]

TOTAL: 100

ANNEXURE 1

QUESTION 2.1

2.1.1



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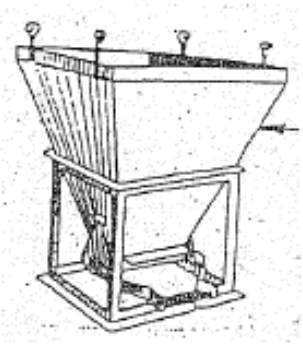

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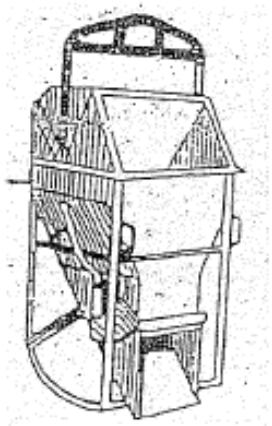

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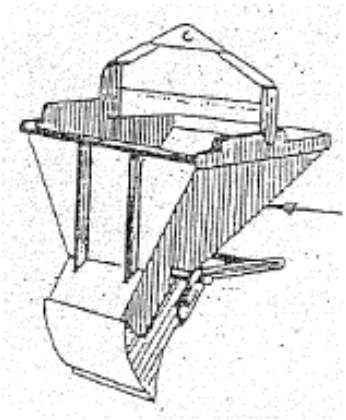
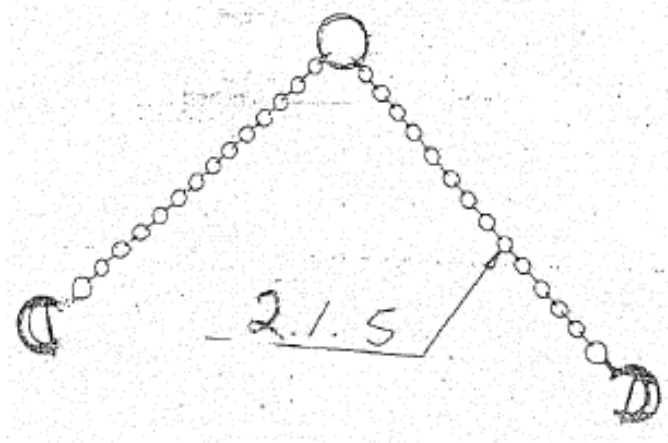
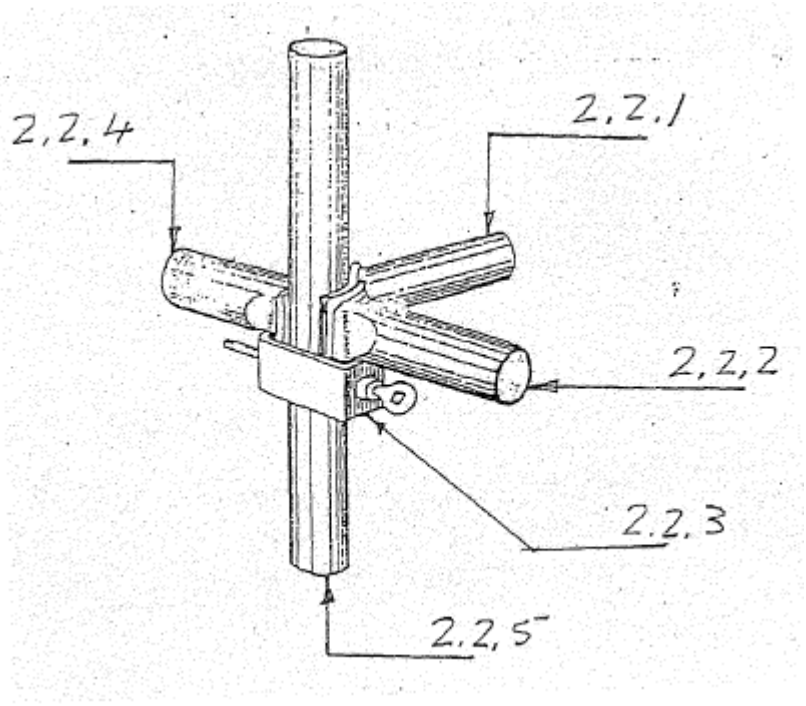


2.1.5



ANNEXURE 1

QUESTION 2.1



Past Examination Papers

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

APRIL 2012

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N5

(**4090045**)

22 March 2012 (X-Paper)
09:00 – 12:00

This question paper consists of 7 pages and an annexure.

TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. The length of the answers should depend on the marks allocated.
5. Answer in full sentences where applicable.
6. Incomplete, cryptic phrases will be penalized.
7. Use your own words.
8. Write neatly and legibly.

QUESTION 1

Give ONE word/term for each of the following descriptions by choosing a word/term from the list below. Write only the word/term next to the question number (1.1 -1.10) in the ANSWER BOOK

action column; agenda; attendance register; closing; constitution; engineer; executive; minutes; motions; quorum; secretary; site agent; seconder; chairperson

1.1 A list of business items or activities to be dealt with at a meeting in a specific order.

1.2 Point of discussion or proposals which fall under the so-called new business.

1.3 The minimum number of members to be- present to ·be able: to take resolutions.

1.4 The person who ensures that all discussions are relevant and addressed to the chair and that adequate opportunity is given to all.

1.5 The executive official on whose efficient shoulders the whole administration rest.

1.6 The report of the resolutions taken at a meeting but also includes an impartial version of the proceeding at a meeting.

1.7 A list on which the number of people present are carefully stipulated.

1.8 The rules by which meeting are governed.

1.9 The members who do not take resolutions, but make recommendation to the general meeting.

1.10 The person who supports a proposal before it can be voted on.

[10]

QUESTION 2

Complete the following paragraphs on the handling of building materials by filling in the missing words. Write only the missing word or phrase next to the question number (2.2 - 2.1 0) in the ANSWER BOOK.

Whenever materials are needed on site, the general foreman contacts the 2.1 (...) department at head office to order it from supplies. As soon as the materials arrive on site the foreman will check its quality and will sign the 2.2 (...). At the storing areas and

sheds the 2.3 (...) has to keep record of all materials which are received or dispensed.

At present in South Africa a number of security measures have to be taken as 2.4 (...)has become a real problem. Another big problem is 2.5 (...)of the materials, which means that they are not handled properly and that offcuts and leftovers are left lying around, get damaged or are thrown away.

Bulk material such as sand, crushed stone and bricks should be off-loaded and stored as near as possible to the 2.6 (...). Timber, cement in sacks and other materials that is easily damage by 2.7 (...)must be kept under shelter. Chemicals like paint and acid which 2.8 (...)must be securely locked away. Sanitary fittings and gloss panels should be stored on racks with enough space in between, because 2.9 (...). Iron ware, taps and other small items have to arrive as late as possible on site and are fixed at the soonest stage possible, because 2.1 0 (...).

[10]

QUESTION 3

Choose the correct personnel member for the following definitions on building administration on a construction site from the list below. Write only the personnel member next to the question number (3.1 - 3.1 0) in the ANSWER BOOK.

nominated sub-contractor; unskilled labourer; general-foreman; trades foreman; town planner; clerk of works; storekeeper; artisan; consultant; building control officer; apprentice; operator; select sub-contractor; resident engineer; surveyor; building surveyor

3.1 He/She is the head of one of the various working groups and delegates work to artisans, apprentices and labourers.

3.2 2 It is his/her duty to check the material when it arrives on site, to sign the delivery note and to record the goods.

3.3 A tradesman

3.4 He/She is responsible that the building is built on the right spot, is plumbed and that floor levels are at designed heights.

3.5 A secondary contractor, but concludes a contract with the main contractor.

3.6 It is his/her duty to organise all activities and to aim at a smooth running of the construction.

3.7 The local authority official who makes sure that building regulations are adhered to.

3.8 He/She claims and settles interim payments and the final account with the quantity surveyor.

3.9 He/She represents the architect on site and monitors and certifies work and material to his/her satisfaction.

3.10 He/She represent the engineer on site and monitors and certifies work and material to his/her satisfaction.

[10]

QUESTION 4

In schedule form, name FIVE different earth works categories with TWO types of mechanical plant for each of the categories.

[10]

QUESTION 5

5.1 What is the basic meaning of the following terms?

5.1.1 A contract

5.1.2 A document

5.1.3 Contract document (3)

5.2 Explain ONE use of each of the following documents:

5.2.1 Working drawings

5.2.2 Specification

5.2.3 Bills of quantities

5.2.4 Forms of tender

5.2.5 Principal building agreement (schedule of condition)

5.2.6 Interim payment certificate

5.2.7 Final account (7)

[10]

QUESTION 6

State the following about the general foreman:

6.1 FIVE essential requirements (skills and characteristics) which he/she should have. (5)

6.2 FIVE typical tasks which he/she has to fulfil on a building site. (5)

[10]

QUESTION 7

Study DIAGRAM 1 and DIAGRAM 2 in ANNEXURE 1 (attached} and answer the questions below.

7.1 Give the name of line AB in DIAGRAM 1.

7.2 In DIAGRAM 1, the rising curve, shown as a broken line, indicates (a) ... ,and the falling curve indicates (b) ....

7.3 What is the name of pointY in both diagrams?

7.4 As the curve of the mass-haul diagram (MHO) (DIAGRAM 1) rises above the line AB, the haul is from (a) ... , and when the curve lies below the balance line, the haul is from (b) .. . .

7.5 The total cut volume is represented by the ordinate ....

7.6 In moving earth from cut to fill assume that the first load would be from the cut at (a) ... to the fill (b) ... and the last load form the cut at (c) ... to the full at (d)

7.7 In DIAGRAM 2 EF indicates on the longitudinal section that the cut volume (a) ... . The amount of volume is (c) ... and it falls within the free-haul distance.

7.8 What does CG in DIAGRAM 2 represent?

7.9 The mass-haul diagram is plotted directly below the longitudinal section of the survey ....

[10]

QUESTION 8

8.1 Define each of the following as they relate to network analysis.

8.1.1 Activity (1)

8.1.2 Event (1)

8.1.3 Float (1)

8.1.4 Critical path (1)

8.1.5 Resource smoothing (1)

8.2 When drawing a network, it is necessary to first decide what elements or activities constitute the network and then to ask the following questions on each activity:

What must happen before it?
What may be going on at the same time?
What may happen after it?

Use the following activities to draw a program using the network method.

A Plastering
B First fixing services
C First fixing carpenters
D Second fixing services
E Second fixing carpenters
F Floor screed (5)

[10]

QUESTION 9

9.1 Name and define THREE systematic ways in which construction work can be programmed. (6)

9.2 What is meant by planning in the construction industry? (2)

3.3 State TWO objectives of planning in the construction industry. (2)

[10]

QUESTION 10

10.1 Draw your own diagram to illustrate Simpson's rule formula to determine area. (3)

10.2 Define the following terminology in mass-hauling:

10.2.1 Haul (1)

10.2.2 Station metre (1)

10.2.3 Free-haul and over-haul (1)

10.2.4 Waste (1)

10.2.5 Borrow

10.3 Explain the meaning of bulking and shrinkage in mass hauling.

[10]

TOTAL: 100

ANNEXURE 1

MASS-HAUL DIAGRAM

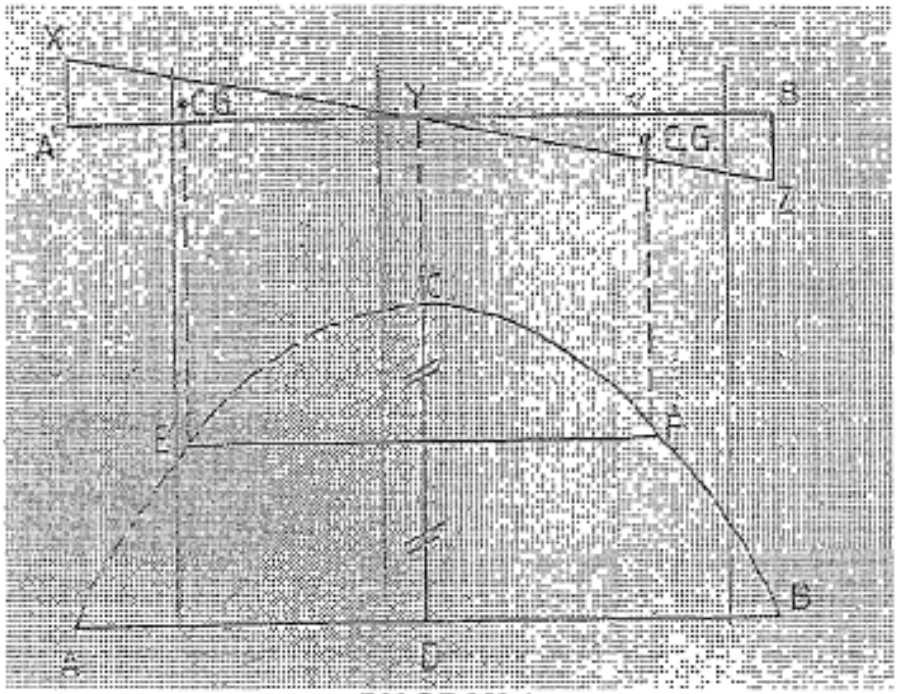


DIAGRAM 1

MASS-HAUL DIAGRAM

Assuming a free-haul distance of 100 m (EF).

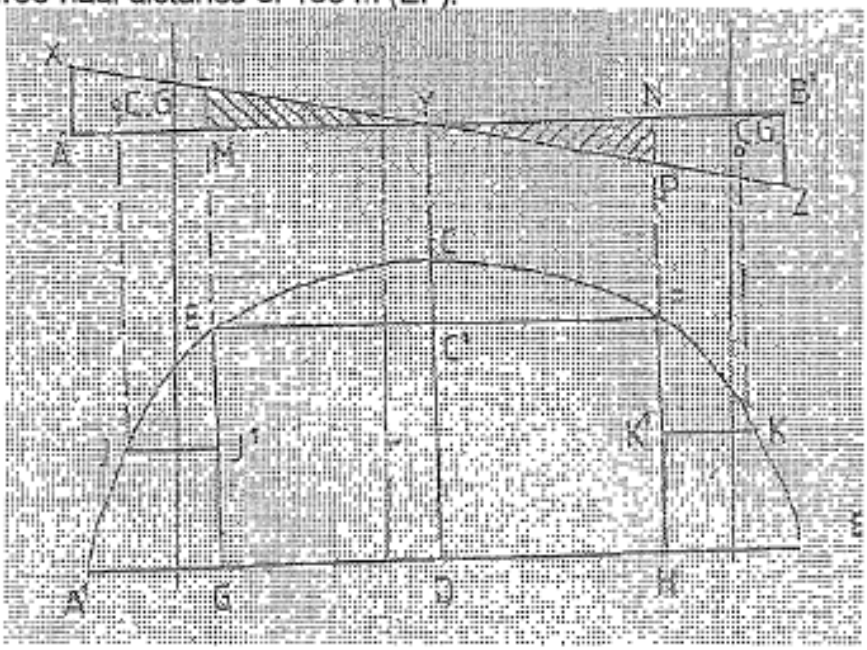


DIAGRAM 2

Marking Guidelines

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

APRIL 2012

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N5

(4090045)

This marking guideline consists of 8 pages and a-page diagram sheet

QUESTION 1

1.1 Agenda

1.2 Minute

1.3 Quorum

1.4 Chairperson

1.5 Secretary

1.6 Motion

1.7 Attendance register

1.8 Constitution

1.9 Executive

1.10 Seconder

[10]

QUESTION 2

2.1 Buying department

2.2 Delivery invoices

2.3 Storekeeper/store clerk

2.4 Fine and theft

2.5 Care

2.6 Works

2.7 Moisture

2.8 Are toxic

2.9 Fragile/Easily damage

2.10 Damage/Theft

[10]

QUESTION 3

3.1 Trade foreman

3.2 Storekeeper

3.3 Artisan

3.4 Surveyor

3.5 Nominated Sub-contractor

3.6 General foreman

3.7 Building control officer

3.8 Building surveyor

3.9 Clerk of works

3.10 Resident engineer

[10]

QUESTION 4

PLANT CATEGORIES
EARTH CATEGORIES PLANT
(a) Excavation (1) Trencher (2) Baacter
(b) Loading (1) Face shovel (2) Hydraulic backacter
(c) Transportation (1) Tipping lorry (2) Trucker
(d) Leveling (1) Grader (2) Dozer
(e) Compacting (1) Rollers (2) Vibrator

[10]

QUESTION 5

5.1.1 CONTRACT:- Means these general conditions of contract and special conditions. Specifications, drawings, tender are written records of matters agreed after the submissions of the contractor's tender. Letter of acceptance and agreement executed in terms of clause 5 together with other documents which the parties have agree in writing shall form part of the contract and such amendments or additions to the contract as way be agreed in writing between the parties. (1)

5.1.2 DOCUMENT: - Means any writing that forms part of contract such as tender documents etc. (1)

5.1.3 CONTRACT DOCUMENT: - Means any writing that forms part of contract such as tender document, drawing and specification etc. (1)

5.2.1 WORKING DRAWINGS: - Is used to outline the shape at the structure of how it should look like at the end of construction. (1)

5.2.2 SPECIFIGATION:- Explain quality and fixing of different materials to the structure (1)

5.2.3 BILLS OF QUANTITIES: - The contractor consult the bills of quantities to find material quantities to be use in different activities (1)

5.2.4 FORM OF TENDER : - Send by the architect to different contractors to fill in the total sum of tendering (1)

5.2.5 PRINCIPAL BUILDING AGREEMENT : - (Schedule of conditions): - It is where the contractor and the employer record all terms agreed upon in terms of contract and to consult it at the later stage when there is a dispute or misunderstanding. (1)

5.2.6 INTERIM PAYMENT CERTIFICATE: -It is issued by the architect to inform the owner about the sum at money due to the contractor as monthly payment during the construction of the project. (1)

5.2.7 FINAL ACCOUNT: - At the end of construction period defect liability period the contractor send a final statement to the architect indicating final account that is due to the contractor. (1)

[10]

QUESTION 6

6.1 FIVE ESSENTIAL REQUIREMENTS (SKILLS AND CHARACTERISTICS WHICH HE SHOULD HAVE)
- He should have technicians diploma in construction management.
- He should be a man of long experience and wide practical knowledge
- He should be a boss to gangers and their men.
- He should have a basic principle on leveling and surveying using surveyor's machines
- He also should have clerical ability sufficient to shuffle up time sheet and get them into required order. (5)

6.2 FIVE TYPICAL TASKS WHICH HE HAS TO FULFIL ON A BUILDING SITE
-He should see to it that safety precautions adhere too by workers on site.
- With his long experience, he should if necessary demonstrate personally how word things should be done.
- He should keep the job going at a right speed and in a right manner.
-He is expected to use both labour and plant productively.
- He spend a lot of his time outside, visiting all part of the work under his control at least twice a day. (5)

[10]

QUESTION 7

7.1 Balance line

7.2 (a) Cut (positive)
(b) Fill (negative)

7.3 Grade points

7.4 (a) from left to right
(b) from right to left

7.5 CD

7.6 (a) X
(b) y
(c) y
(d) z

7.7 (a) L M Y
(b) Y N P
(c) C C

7.8 Centre of gravity

7.9 Centre line

[10]

QUESTION 8

8.1.1 Activity:- Is normally regarded as the work done by a man or gang of men but it may also be something which takes time to perform. (1)

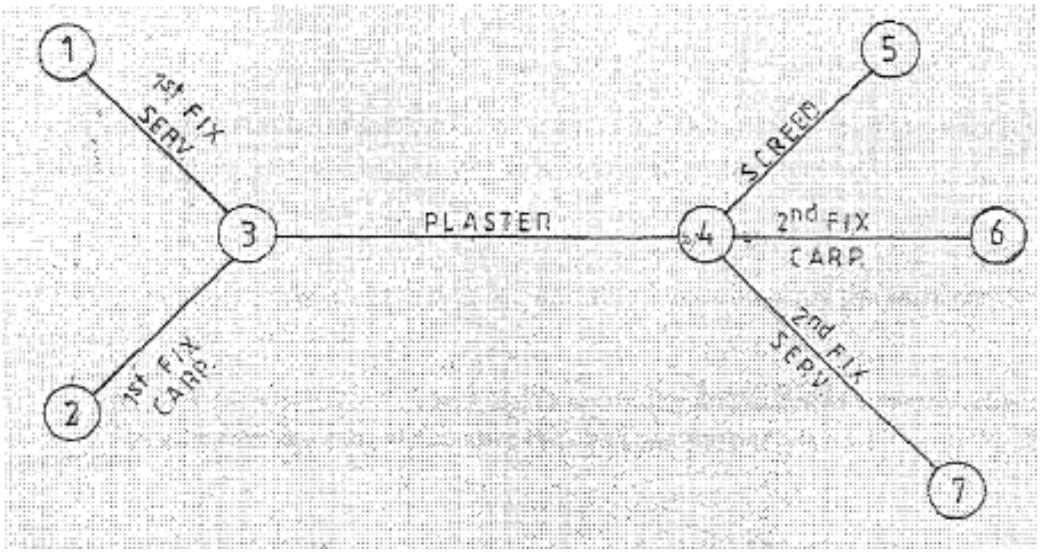
8.1.2 Event:- The circles represents events and distinguished from activities in that they are point in time and do not consume resources whether these be labour, materials or time. (1)

8.1.3 Float:- Is refer to those activities which are not on the critical path. (1)

8.1.4 Critical path:- Is the longest route through the network that any delay in completing the activities on this path will extend the overall project time. (1)

8.1.5 Resource smoothing:- This is when you want to provide a more uniform use of resource throughout the contract period and you delay the start of some other non-critical activities. (1)

8.2



(5)

[10]

QUESTION 9

9.1 The master or overall programme :- Sometime called long-term programming covers the full contract period and includes the complete works in broad overall terms. Time is usually plotted in months and weeks, with dates and contract week numbers entered holiday periods should also be shown, since allowance must be made for these reduced or lost production spells.

Phase or section programs :-Sometimes called medium term programming should now be prepared for every major items that requires more detailed treatment e.g. such separate building or construction phase of significant size. Each line of master programme, if required, is magnified and considered in closer detail the form of programme chart may be a before, indicating weeks with dates and serial numbers, but covering only part of the contract period.

Short-term programming :-It requires more magnification of items. In this type of programming master and section programme are further enlarge to week and says programming. This type of programming reach much closer to individual term than section programme.

(6)

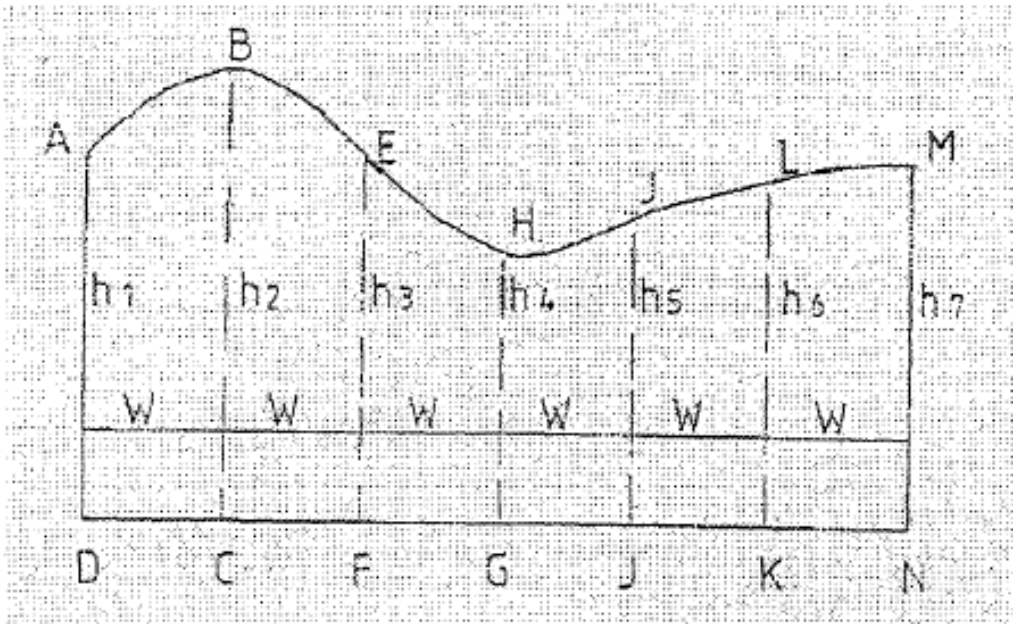
9.2 Planning:- Can be defined as the devising of a scheme for doing, making, or arranging a project or programme bef0re the work being planned is under way. (2)

3.3 (a) To show the quickest and cheapest method of carrying out the work consistent with the available resources.
(b) To provide information on material quantities and essential delivery dates, the quantity and capacity of the plant required and the periods it will be on site. (2)

[10]

QUESTION 10

10.1



(3)

SIMPSON'S RULE :-A=W [(h1 +h7)+ 4(h2+h4+h6)+(h2+h5)]-

10.2.1 Haul : - refers to the volume of material multiplied by the distance moved, expressed in 'stations metres' (1)

10.2.2 Station metre (stn m):- Is 1m^2 of material moved 100 mm, thus 20m^3 moved 1500 m is a haul of 20 x 1500/1 00 = 300stn m. (1)

10.2.3 Contractor may offer to haul material a distance of say 150m at 50 p per m^3 and that is called free-haul distance, but thereafter for any distance hauled beyond 150 m the contractor may require an extra 5p per m^3 moved per 1OOm and that is over-haul distance (1)

10.2.4 Waste.:- Is the material excavated from cut but not used for embankment fills (1)

10.2.5 Borrow:- Is the material needed for the embankments, secured not from roadway excavation but from elsewhere. It is said to be obtained from a 'borrow pit'.

10.3 Bulk and shrinkage:- Excavation of material causes it to loosen, and thus its excavated volume will be greater than its in-situ volume. However, when filled and compacted, it may occupy a less volume than when originally in-situ (i.e.) ordinary earth is less by about 10% after filling, whilst rock bulk by some 20% to 30%. To allow for this, a correction factor is generally applied to the cut or fill volume.

[10]

TOTAL: 100

ANNEXURE 1

MASS HAUL DIAGRAM

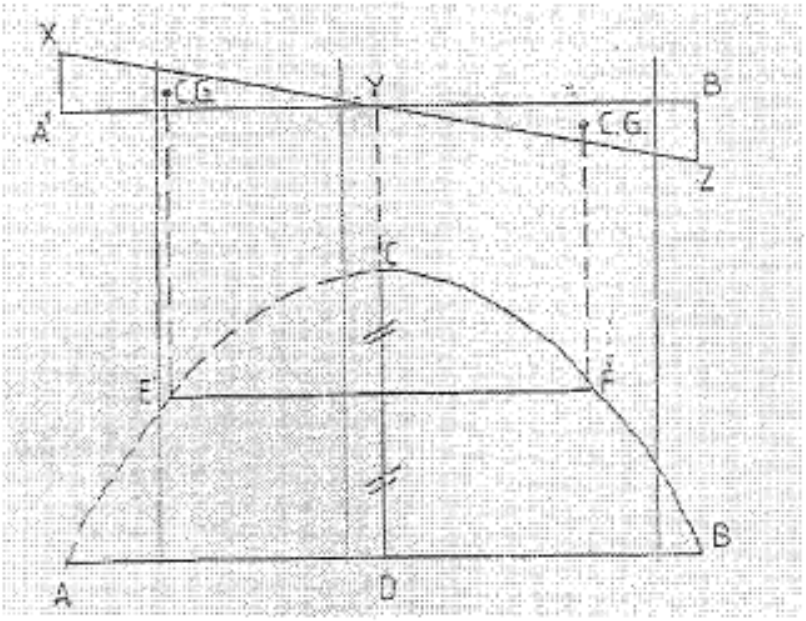


DIAGRAM 1

MASS HAUL DIAGRAM

Assuming a free-haul distance of 100 m (EF).

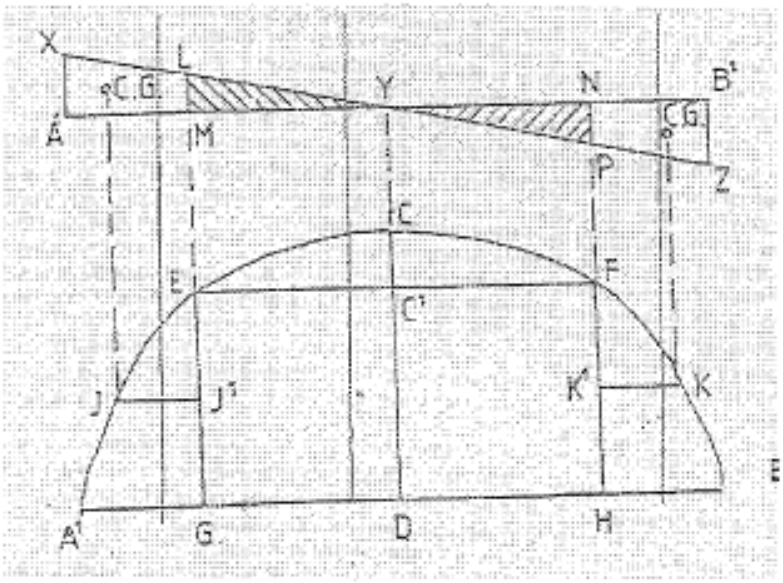


DIAGRAM 2

N5 Building Administration is one of many publications introducing the gateways to Civil Engineering Studies. This course is designed to develop the skills for learners that are studying toward an artisanship in the Building and Civil Engineering fields and to assist them to achieve their full potential in a building construction career.

This book, with its modular competence-based approach, is aimed at assisting facilitators and learners alike. With its comprehensive understanding of the engineering construction environment, it assists them to achieve the outcomes set for course.

The subject matter is presented as worked examples in the problem-solving-result methodology sequence, supported by numerous and clear illustrations.

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The author, Chris Brink is well known and respected in the engineering and related fields. Their extensive experience gives an excellent base for further study, as well as a broad understanding of engineering technology and the knowledge to success.

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- N2 Engineering Science
- N3 Engineering Science
- N4 Engineering Science

- NCOR Mathematics
- N1 Mathematics
- N2 Mathematics
- N3 Mathematics

- N1 Fitting and Machining
- N2 Fitting and Machining

- N3 Mechanotechnology

- NCOR Engineering Drawing
- N1 Engineering Drawing
- N2 Engineering Drawing
- N3 Engineering Drawing

- N1 Electrical Trade Theory
- N2 Electrical Trade Theory

- N3 Electrotechnology

- N1 Refrigeration Trade Theory
- N2 Refrigeration Trade Theory
- N3 Refrigeration Trade Theory

- N1 Metalwork Theory

- N2 Welder's Theory

- N1 Rigging Theory
- N2 Rigging Theory

- N1 Plating & Structural Steel Drawing
- N2 Plating & Structural Steel Drawing
- N3 Plating & Structural Steel Drawing
- N4 Plating & Structural Steel Drawing

- N4 Machines & Properties of Metals

- NCOR Industrial Communication

- N1 Industrial Electronics
- N2 Industrial Electronics
- N3 Industrial Electronics

- N1 Motor Trade Theory
- N2 Motor & Diesel Trade Theory
- N3 Motor & Diesel Trade Theory

- N3 Supervision in the Industry
- N4 Supervisory Management
- N5 Supervisory Management

- N3 Industrial Organisation & Planning

- N1 Water & Wastewater Treatment Practice
- N2 Water & Wastewater Treatment Practice
- N3 Water Treatment Practice
- N3 Wastewater Treatment Practice

- N1 Plant Operation Theory
- N2 Plant Operation Theory
- N3 Plant Operation Theory

- N4 Chemical Plant Operation
- N5 Chemical Plant Operation
- N6 Chemical Plant Operation

- N4 Chemistry
- N5 Chemistry

- N6 Chemical Technology

- N1 Plumbing
- N2 Plumbing

- N1 Woodworker's Theory

- N2 Carpentry & Roofwork Theory

- N4 Building & Structural Construction
- N5 Building & Structural Construction
- N6 Building & Structural Construction

- N4 Building & Structural Surveying
- N5 Building & Structural Surveying
- N6 Building & Structural Surveying

- N4 Building Administration
- N5 Building Administration
- N6 Building Administration

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