N4 Building Administration

Gateways to Engineering Studies - Chris Brink

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Gateways to Engineering Studies

Building Administration N4

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Past Examination Papers and Marking Guides

Icons used in this book

We use different icons to help you work with this book; these are shown in the table below.

Icon	Description	Icon	Description
	Assessment / Activity		Multimedia
	Checklist		Practical
	Demonstration/ observation		Presentation/ Lecture
	Did you know?		Read
	Example		Safety
	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

Organizational Structure and Professional Consultants

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

- Describe and discuss who is who in the building industry.
- Describe and explain the design team with respect to:
  - The Employer
  - The Architect
    - Pre-contract duties
    - Contract period duties
    - Post-construct duties
  - The Surveyor
  - Town Planner
  - Engineers
    - Structural;
    - Civil;
    - Mechanical; and
    - Geo-technical / Soil Engineers
  - Quantity Surveyor
    - Pre-Contract Stage
    - Post Contract Stage
  - Building Control Officer

1.1 Introduction

In this module we will discuss persons and consultants and their duties and responsibilities in a building project.

Architects and designers of buildings need to be clear about what a client needs from a building. They then work closely with the construction team,

which includes labourers, to ensure that the client's needs materialise as a fully functioning building. We will consider the following role players:

- Employer (or client),
- Architect,
- Structural engineer,
- Structural surveyor,
- Mechanical engineer,
- Electrical engineer,
- Resident engineer,
- Clerk of works,
- Geotechnical engineer,
- Quantity surveyor,
- Contractor and subcontractor, and
- Local authority building inspector.

Figure 1.1 shows various stakeholders that interact with the architect or designer.

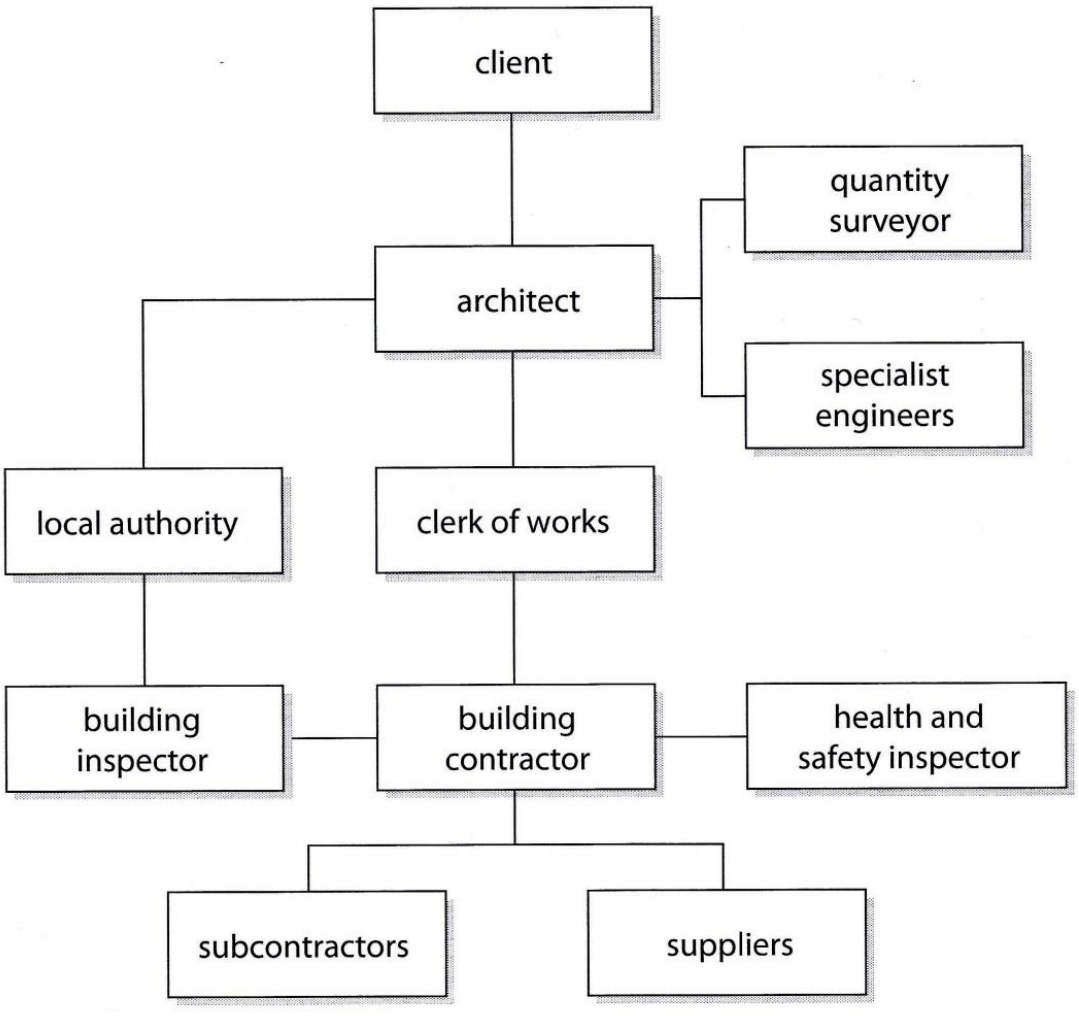


Figure 1.1 Various stakeholders that interact with the architect

1.2 The employer (Client / Owner)

The person, company or institution who desires to have a building erected could be referred to as the ultimate owner. The professional team such as the architect, the engineers and the quantity surveyor often refers to him/her as their client.

Nevertheless, officially he is called the employer as he pays the fees for the designing team and indirectly he pays the salaries and wages of the building firm's employees by paying the total amount what it will cost to erect the building.

The employer has to consider the legal responsibilities regarding the land by consultation with a lawyer. The financial aspects have to be dealt with by banks and financial institutions.

At the same time the employer has to approach an architect, having first selected him or her either by recommendation or through social contacts and arrange for preliminary discussions about the proposed project.

The employer thus appoints the designers who have to put his ideas on paper and who will act as the employer's agents for the project.

In case of an ordinary building project the architect is usually the co-ordinator of this team and in the case of a civil project an engineer will head the team.

The employer has to analyse and to collect all relevant information that is available to him in order to give the designers the clearest and best scope of his requirements with special references to:

- Location of a suitable site
- Space requirements and position on the site
- Needs of the employer and possibilities of new project
- Budget planning
- Time period for design and construction

During the construction works the employer should not interfere with the project. If his needs change or if he has other concerns he should only work through his agent, the architect.

The sole duty of the employer is to make the monthly payments to this contractor as recommended by the quantity surveyor and certified by the architect.

As soon as the contractor takes possession of the construction site, the employer shifts his liability of his property over to the contractor. This means that the employer is no longer responsible for any accidents etc. After practical

completion the new building will be handed over to him again and he has taken back the said liability.

After all defects are repaired and as soon as the quantity surveyor is finished with the final account the employer makes his final payment.

1.3 The Architect

At the initial stage or any building project, the work involved is carried out by the design team who is working in close contact with the client. The client is the future building owner, officially called the employer.

The design team is headed by the architect who, up to the stage where the completed project is finally handed over, has co-ordinated this team and the construction team.

The professional team comprises of the employer and his advisors (bank, lawyer) the consultants and the architect's own designers and they compile a full set of documents of the building which is to be erected.

When the employer and the contractor sign the contract, we meet up with the construction team and the architect becomes the manager for the employer and ensures that the work is carried out in accordance wi1h the contract documents.

The architect also is the arbitrator who ensures that all queries and disputes are settled in accordance with the terms of the agreement.

1.3.1 Pre-Contract Duties (design stage)

Appointment - This is the starting point of the pre-contract preparation. The client/employer will approach an architect for preliminary discussions about a proposed project.

The architect will interpret the employer's wishes and will explain the possibilities advise the employer accordingly.

- **Selection of consultants** – the architect recommends and appoints a quantity surveyor and various consulting engineers. He co-ordinates these advisory services.
- **Brief design** – The desires and needs of the employer are listed and the limitations on the costs of the building are stated. After a feasibility study the architect- assisted by the consultants-transfer the requirements and possibilities into shape and size by means of sketches.
- **Preparation and collection of tender documents** - After the employer has approved of the design according to his budget the architect prepares drawings and specifications and sees to it that they are approved by the Local Authorities.

- **Calling for tenders** - The- architect advises the employer of suitable builders who should be invited to tender. Upon receipt or tenders he advises the employer as to the selection of a suitable contractor.
- **Final contract documents**- The architect finalises and gathers the documents which must be signed by both: the employer and the successful tenderer (the contractor).

1.3.2 Contract Period Duties (Construction Stage)

- **Supervisor** – The architect takes the full responsibility for the contract under his direction. He controls and supervises the progress on the work to ensure good quality of materials and workmanship and that it is carried out in accordance with the contract documents and the conditions of the contract. For that he will make regular site inspections. He may appoint a CLERK OF WORKS to assist him in his duty.
- **Disputes** - The architect solves problems on site and quarrels between the various parties. He has to be available to provide guidance to the general foreman.
- **Sub-contracts**- For specialist's work he may appoint nominated sub-contractors. For certain specialised or purpose made materials he may want to nominate certain suppliers.
- **Changes**- He issues variation orders for any additions or omissions from the contract. The original working drawings have to be revised as soon as deviations become necessary.
- **Payments** – He issues interim payment certificates as the work proceeds, usually at monthly intervals. These are based on valuations made by the quantity surveyor. The employer is obliged to pay the contractor accordingly.
- **Progress reports** – He keeps the employer informed about the progress of the project. He has to be available for discussions with the employer.
- **Site meetings** – He chairs the regular architect's site meetings to co-ordinate all aspects of the work.

1.3.3 Post-Contract Duties (completion)

- **Handing over** - The practical completed project is to be returned to the employer for occupation. After the maintenance period (officially called the "patent defects liability period") he does the final handing over.
- **Snag lists**- At the stage of handling over he carries out inspections and issues the completion list with all unfinished items and later he issues the defects list with all faulty work which has to be rectified.
- **Certificate of completion**- It is the architect's responsibility to free the contractor of all his obligations after finishing the works satisfactorily.
- **Final certificate**- After all the final account calculations are done he issues the final certificate which will ensure that the contractor receives all outstanding monies from the employer.

1.4 The Surveyor (Land surveyor)

The surveyor who is recommended by the architect and who is engaged by the employer very early during the pre-contract stage must measure the surface of the land and must establish the levels to draw the maps with the contour lines.

He starts his work by finding the municipal beacons (site pegs) and finally may also draw the site layout plan.

1.5 The Town Planner

Town planners are members of the Local Authorities and develop the basic layout plan of townships and suburbs. This is done long before the employer engaged the design team.

Still, the town planner may be consulted to give esthetical guidelines to what is allowed and preferred in a certain township or suburb.

The various municipalities (Local Authorities) lay down principles to which type of building, boundary walls etc. are acceptable for a certain area. The designers have to restrict their design accordingly.

The town planner acts upon complains of the community if the new structure is below the standard and norms of the neighbourhood.

1.6 The Engineers (Consulting Engineers / Consultants)

Part of the consultants' responsibility is to assist the architect in the design of the project within the scope of their specialist fields. In the case of all fields the engineers have to determine the needs of the project regarding the safety of the structure, that means:

- Loads to be sustained by the building
- Power supply required by appliances, lights and machines etc.
- Sanitary plumbing, drainage and sprinkler systems
- Fire escapes

After the architect completed the basic sketches with dimensions according to the employers' need the engineers produce calculations, designs and drawings to make the basic design possible.

Only after that the architect can produce the final working drawings within all finishing details.

1.6.1 Structural Engineers

Any reinforced concrete such as columns, beams and slabs or structural steelwork like external fire escape stair cases or special foundations are required to be designed by structural engineers.

1.6.2 Civil Engineers
Civil engineers are structural engineers who specialise in reinforced concrete work.

1.6.3 Electrical Engineers
They design the power network within a building. This means that they have to determine the transformer requirements, the distribution board layout, the conducts and positions of the light fittings and power supply points.

1.6.4 Mechanical Engineers
The services of mechanical engineers are necessary when moving parts such as escalators conveyor belts, lifts and pumps are part of the building. Mechanical engineers must work closely together with the electrical engineers because most mechanical appliances are driven by electricity.

1.6.5 Geo-technical/ Soil Engineers
They ensure the stability of the earth below and adjacent to the proposed building by means of piles and lateral support.

All these consultants must obey the prescribed regulations with regard to their designs. Engineers are responsible for their designs. Therefore they are required to do regular inspections and have to visit the site as the need arises.

The required tests on the works (for example: cube tests, drain tests and loading tests for machines) must be arranged by the respective consultants to ensure that the design and specifications are complied with.

After completion of that particular part they must certify the proper and satisfactory construction and / or functional and safe working of it.

For the purpose of the constant supervision an engineer may appoint a RESIDENT ENGINEER who will work permanently on site. The resident engineer's duties are very similar to that of the clerk of works.

Engineers have to attend the architect's meetings so that they can give clarification and guidance or to make decisions on uncertain matters to allow the construction work to proceed.

1.7 The Quantity Surveyor
The quantity surveyor is a consultant who specialises in financial matters. He is able to establish the costs of a structure at the various construction stages.

To be able to do that he must have a thorough understanding of building construction.

1.7.1 Pre-Contract Stage (Design stage)

- The first duty of the quantity surveyor is to prepare an approximate estimate from sketches.
- When this estimate is compared with the employer's budget the quantity surveyor is able to give advice where to save or how to spend extra money.
- As soon as all the drawings -those from the engineers too- are ready, he will supply the architect (indirectly the employer) with a blank set of the bills of quantities. These are used by the tenderers to fill in their rates for the work items to arrive at a total tender price.
- On receiving the tenders back from the tenderers the quantity surveyor will check the bills for any serious calculation errors which could cause complications at a later date. (Note: that the actual tender price may not be adjusted!)

1.7.2 Contract Stage (Construction stage)

- The quantity surveyor will carry out monthly valuations of the so far completed works. This is done on site together with the contractor's building surveyor. The architect takes this valuation as a basis to issue the interim certificate which allows the contractor to receive a monthly payment from the employer.
- The quantity surveyor is responsible for the cost control. He will evaluate changes to warn the architect as soon as extras seem to exceed the contingency sum. (Note that the final contract price may not exceed the tendered price plus the contingency sum. On the other hand, the employer is not allowed to cut the tendered price with omissions. Both cases would be cases of contract breach).
- Variation orders must then be measured in all detail to establish its cost and to be included into the final account.
- Provisional works such as foundations, drainage and external works have to be re-measured. This is done on site together with the respective trade foreman or sub-contractor.

1.7.3 Post-Contract Duties (after completion of the works)

The final account must now be prepared / completed. Variations, which had to be measured as day work items, have to be finalised together with the contractor.

From the total amount of the final account all previous interim payments are subtracted. This will be the last payment to the contractor. Based on this calculation the architect will issue the final certificate to let the employer make this final payment.

1.8 The Building Control Officer (Inspector)

The building control officer is not employed by the employer (client / owner) but by the local authorities. He is required to ensure that the building regulations are conformed to.

He has a responsibility to the public and to the community at large via the national and regional building regulations. This serves a dual purpose in that he not only safeguards the public but also ensures that the employer's building is built to set standards and norms.

It is an offence to commence any construction before the local authority has granted permission to do so. The drawings and specifications have to be approved in the building control officer's office of the municipality.

At various stages and before the building may be occupied the building control officer must be called to do inspections and finally to sign it off as safely completed in accordance with the initial approved documents.

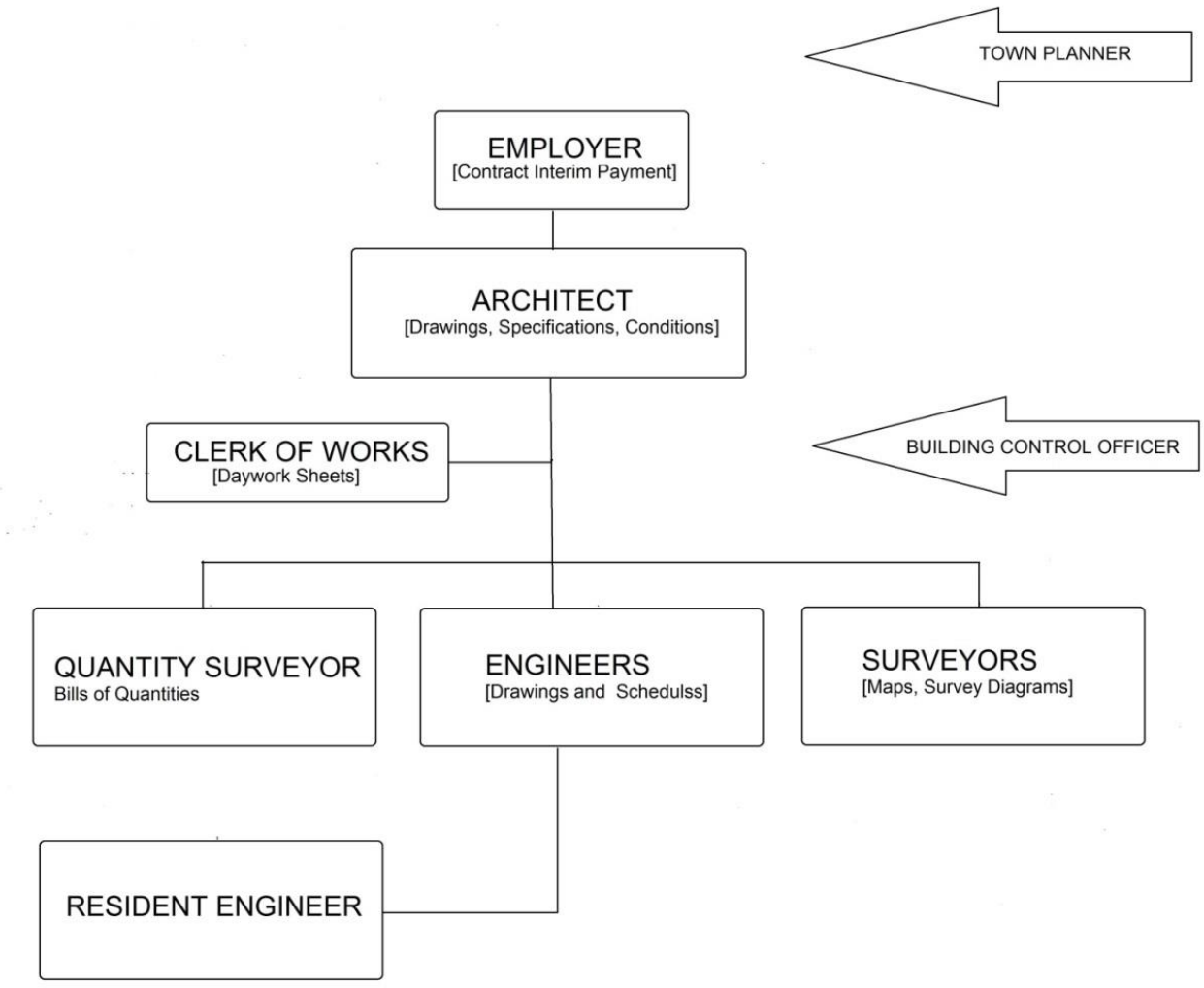


Figure 1.2 Professional Consultants on a building project

1.9 The Clerk of Works

The clerk of works is the representative of the employer on the building site. He works under the instructions of the architect. He acts as a liaison between the employer, the architect and the contractor.

He should have considerable architectural, constructional and engineering knowledge. He often is a retired artisan or foreman or former architect who loves the outdoors.

He must have sound knowledge of all the contract documents, the building regulations and how the building industry operates. He has tact, is helpful, patient and very precise.

His principle duty is to ensure the performance of the terms of the contact on the site. To do this successfully he must be observant and know the architect's office and its standards and what is expected of him; he must know and really desire for himself quality of work before anything.

He must understand fairness to all parties concerned in the interpretation of the terms of the contract.

He must be able to keep his judgement unbiased by the influences which come in upon him to exact a little more here and release a little more here, which on most projects is a relentless pressure from all sides upon his judgement and his sense of fairness. He must have a respected personality, a professional approach and must feel responsible for his decisions.

He is issued with a complete set of contract documents, drawings, specifications and blank bills of quantities (without prices).

Copies of all correspondence and letters passing between the architect's office and contractor, except of a strictly confidential matter, most letters between the employer and the architect applicable to the carrying out of the work are issued to him.

The clerk of works attends to all site meetings and takes a leading part in the discussions. He keeps the architect's office informed by telephone or writing of all developments on the site. A weekly report is to be written by the clerk of works and delivered by the end of the week to the architect's office so that it may be in the office the following week.

1.9.1Duties of the clerk of works

As he represents the architect and the employer he channels the architect's instructions to the construction team via the general foreman.

He acts as a quality controller and will inspect workmanship as it progresses end approve of it. Difficulties should be, anticipated and not left to become accomplished facts to be rectified at unnecessary expense. Unacceptable workmanship and materials may be rectified on his instruction to the general foreman without recourse to the architect.

He must, above all have a thorough understanding of the interpretation of the contracts, specifications, drawings and bills of quantities. He may assist the contractor to clarify some complicated detail in the documents.

He must keep a careful record of all deviations from the contract documents, which will end up as variation orders. Special attention is required for the checking and authorising day work sheets. (Day-work sheets are forms which have to be filled in in respect of labour hours, material and plant for variation orders which are impossible to valuate with the bills of quantities as basis.)

He must collect details for the work which is measured provisionally, and as such is subject to re-measurement as executed by the quantity surveyor, particularly underground work such as drainage, water supply and excavation depths.

He maintains a carefully written-up daily diary and an instruction book. His diary includes day-to-day happenings on the site. It is important that he records anything and everything that may be required in the final stage of the works, either by the architect, quantity surveyor, engineer or employer.
Referring to this diary, disputes with the contractor can often be avoided or clarified. To keep all this paperwork up to date, the clerk of works should be a self-disciplined, independent worker.

He submits to the architect weekly reports, recording in them progress of work, material on site, inclement weather and conditions of plant and equipment and the names of all visitors to the site. The work of sub-contractors is also covered in his reports and above all anything that is out of the ordinary, such as details about accidents and other problems.

He attends all site meetings and is informed about happenings and deviations and can thus communicate valuable information. At an architect's meeting he often takes the minutes (writes the report of the meeting) or may be the chairperson when the architect cannot be present.

1.9.2 Interaction with the clerk of works and the foreman

The foreman has to supply the clerk of works with a convenient site office.
The clerk of works does inspections on a continuous basis and must be allowed access to the works at all times.

If he invested in a good relation with the building firm and the foreman, it will definitely pay off. However the clerk of works is not to interfere with the workers, he has to work through the general foreman at all times.

It is the general foreman's duty to call the clerk of works for taking, down data (foundation details and so on) before it will be hidden or closed up.

Variations, which cannot be assessed by using descriptions and rates from the bills of quantities, must be recorded by filling in day-work sheets. The foreman must see to it that the data is checked and signed by the clerk of works.

Because the clerk of works is the architect's representative, he may be asked for advice instead of contacting the architect himself. He is the link to the architect. The construction team should not contact the architect or other consultants directly, but should do so via the clerk of works.

The clerk of works helps to interpret the documents and to understand the construction detail. He will forward instructions from the architect to the construction team or may forward information from the contractor to the design team.

The general foreman has to accept the clerk of work's authority as chairperson at meetings.

1.9.3 Duties and responsibilities of the clerk of works

- The employer shall be entitled to appoint a clerk of works.
- The clerk of works' duties shall be to act solely as inspector on behalf of the employer under the direction of the architect. The contractor shall afford every reasonably facility for the performance of that duty.
- The clerk of works will make regular reports to the architect and it is important that he will keep a dairy that will be invaluable in cases of any disputes.
- The clerk of works attends all site meetings and takes a leading part in discussions. He must keep careful record of all deviations from the contract documents so that the design team can issue proper variation orders to compensate the builder. If costs for these deviations cannot be calculated from the existing contract documents the clerk of work must check and certify the day-work sheets.
- If he acts as secretary at site meetings it is his function to record the minutes of that meeting. For the quantity surveyor he collects data of such works as the foundation and the drainage which are later covered up.
- He should have a thorough knowledge of building construction and thus can help to sort out uncertain detail on drawings and in the practice.
- He must understand fairness to all parties concerned in the interpretation of the terms of the contract.

1.10 Roles and responsibilities of other stakeholders

Table 1.1 contains a summary of the different stakeholders in a building project and explains their responsibilities.

Key users (stakeholders) in the construction industry and their responsibilities		
Key user	Description	Responsibilities
Client	The person or company that wants the structure built.	• The client starts the building process by commissioning an architect to design the structure. • The client sometimes contracts a contractor to build the structure if the architect does not do so.
Architect	The person who is trained to design buildings and draw up plans for them.	• The architect designs the structure by creating the plans and drawings that the contractors use to build the structure. • The architect must know the building regulations so that he or she designs a structure that complies with these regulations. • The architect also makes sure that the building is being constructed according to the plans and drawings created to suit the needs of the client. • So, the architect is responsible for the way the structure looks.
Project manager	The person who will manage the entire construction of the project for the client.	• The project manager is responsible for project planning. • The project manager prepares the tender documentation that is needed to select the contractor. • The project manager makes sure the project runs according to the project plan. • The project manager runs site and client meetings. • The project manager makes sure that the contractor is paid on time. • The project manager prepares regular reports.
Structural engineer	The person who makes sure that the structural elements of a building, bridge or road (among other things) are designed and built correctly, for safety and strength.	• The structural engineer plans and designs the structural elements, such as the beams, columns and floor slabs that a structure will need. For this reason, a structural engineer must also know about loads. • The structural engineer visits the building site to inspect the building to make sure that it is being built according to their specifications. • The structural engineer arranges to have samples of materials tested to make sure they are of good quality.

Table 1.1 Different stakeholders in a building project

Key users (stakeholders) in the construction industry and their responsibilities		
Geotechnical engineer	The person who analyses the soil conditions on a site.	• The geotechnical engineer performs the site soil investigation and designs the foundations for the structure. • He or she needs to know the condition of the earth on which a structure will be built, for example, whether the ground is rocky, or whether there are earthquakes in that area.
Quantity surveyor	The person who draws up a bill of quantities (or materials) from the architect's plan	• The quantity surveyor uses the plans and drawings to determine the quantities of materials that the structure will need. • From these quantities, the quantity surveyor is able to control the costs of the building contract.
Resident engineer	An experienced technical person (usually a civil engineer) who resides or works on a major civil construction site to represent the interests of the client.	• The resident engineer can be a civil, geotechnical, electrical or structural engineer. • The resident engineer monitors and verifies that work is done according to the contract documents. • The resident engineer must be able to communicate clearly with contractors, design engineers, utility companies, government and public agencies, the community in which they are working, and, most importantly, the client. • He or she answers contractors' questions and solves difficult problems. • The resident engineer does quality control inspections and scheduling.
Clerk of works	The clerk of works is the client's representative on a building site. This person usually works under the instruction of the architect to ensure that work is done strictly in accordance with the specification. A clerk of works has a wide knowledge of building construction and keeps accurate records of the work that is done.	• The clerk of works makes sure that the contractor is adhering to building standards and building the structure according to the specifications of the architect and engineer.

Table 1.1 Different stakeholders in a building project

Key users (stakeholders) in the construction industry and their responsibilities		
Contractor	The person or company that is contracted to build a structure. A contracting company would employ supervisors called foremen to work directly with the construction workers and other service providers.	• The contractor is responsible for building the structure according to the contract documents. The contractor supplies all the building materials, the labour, the building equipment and the services to get the structure built.
Subcontractor	The person who takes on part of the contractor's work if the work is specialised, such as electrical, plumbing or air conditioning and lift installations.	• Sometimes a contractor will subcontract part of the construction work, such as the plumbing or roofing, to a subcontractor. • The subcontractor specialises in the work that he or she has been subcontracted to perform. • The subcontractor is responsible for doing all of the work that the contractor has subcontracted him or her for.
Building inspector	The person who is employed by the local authority to inspect buildings.	• The building inspector inspects buildings as they are built to make sure that they are built according to building regulations. • The building inspector does inspections when the foundations are dug, the drainage is installed and the building is finished.
Mortgage lender	The person or institute who lends the client money to build the structure. This is usually a bank or financial institution.	• The mortgage lender is responsible for financing the building project, then getting the money back in repayments once the structure has been built. • The mortgage lender needs to find out if the borrower can afford to pay back the loan.

Table 1.1 Different stakeholders in a building project

Now test your knowledge by doing the activity that follows.

Activity 1.1

1) Briefly discuss the main duty of the following persons and consultants:
   a) Employer (Owner / Client)
   b) Architect
   c) Town Planner
   d) Surveyor
   e) Quantity Surveyor
   f) Civil Engineer
   g) Structural Engineer
   h) Electrical Engineer
   i) Mechanical Engineer
   j) Resident Engineer
   k) Building Control Officer
2) Explain the functions of the architect.
3) Prepare a line diagram to show the relationship between the members of the professional team. Consider the period when the structure is designed and put up. Include, in brackets, the relevant documents with the respective persons.
4) Discuss the appoint AND functions of the following professionals in the building industry:
   a) The architect
   b) The civil engineer
   c) The quantity surveyor
5) Explain how the following professional consultants interact AND what each will do for certain construction projects:
   a) Architect
   b) The various engineers
   c) Quantity surveyor
   d) Structural surveyor
   e) Building control officer
6) Answer the following questions about the clerk of works:
   a) Who does he represent?
   b) Name TWO (2) qualifications he should have.
   c) Name THREE (3) characteristics he should have.
   d) Name FOUR (4) duties he has.
7) Clearly describe FIVE (5) of the major duties of the clerk of works.
8) Answer the following questions about the clerk of works:
   a) Who pays him, in other words, who is his employer?
   b) What role does he fulfill for his employer?
   c) Name ONE (1) minimum qualification and ONE (1) vital characteristics he should have.
   d) May he issue any instructions?
   e) May give advice?

f) What information must he collect for the quantity surveyor?
g) What must his report include to the architect?
h) Why does he keep a diary?
i) What does he record in the diary?

9) You are the general foreman on a construction site. Fully explain your interaction with the clerk of works.

Self-Check

I am able to:	**Yes**	**No**
Briefly discuss the main duty of the following persons and consultants:		
o Employer (Owner / Client)		
o Architect		
o Town Planner		
o Surveyor		
o Quantity Surveyor		
o Civil Engineer		
o Structural Engineer		
o Electrical Engineer		
o Mechanical Engineer		
o Resident Engineer		
o Building Control Officer		
• Explain the functions of the architect.		
• Prepare a line diagram to show the relationship between the members of the professional team.		
• Discuss the appoint AND functions of the following professionals in the building industry:		
o The architect		
o The civil engineer		
o The quantity surveyor		
• Explain how the following professional consultants interact AND what each will do for certain construction projects:		
o Architect		
o The various engineers		
o Quantity surveyor		
o Structural surveyor		
o Building control officer		
o Clerk of Works		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 2

Departments of a Building Firm / Company

Learning Outcomes
When you have completed this module, you should be able to:

- Describe and explain the building company / firm to include but not limited to:
  - Small
  - Medium
  - Large
- Describe the methods of obtaining business to include but not limited to:
  - Speculation
  - Recommendation
  - Reputation
  - Arrangement
  - Negotiation
  - Tender
  - Open tender
  - Closed tender
  - Negotiated tender
  - Rotation
  - Request
  - Tender process using the BOE (Bills of Quantities)
- Explain and discuss the contractor's head office to include but not limited to:
  - Contracts
  - Estimating
  - Costing
  - Buying
  - Accounts
  - Personnel
- Explain and discuss the organisational structure on a building site to include but not limited to:
  - Contracts Manager

- Project Manager
- General Foreman
- Trades Foreman
- Artisans
- Labourers
- Operators
- Sub-contractors
- Building Surveyor
- Surveyor
- Site clerk
- Storekeeper
- Gate watch / Security

2.1 Introduction

In this module you will understand the overall functions and running of the various departs that are involved with the building firm.

2.2 The Building Firm

The contractor is the construction firm that is in charge of the project. He is the successful tenderer. He is the party that is legally responsible for everything on the site.

This party signed a contract with the employer (client/owner) to build and to deliver the project to the satisfaction of the employer/architect. As ordinary (selected) and nominated sub-contractors work under the contractor, he is often called the main contractor.

In the language of the people the term 'contractor' is used for all builders. Officially this is incorrect. In the building documents only that single firm who has won the tender and has signed the contract with the employer is referred to as the contractor.

2.2.1 Small Firms

- These firms consist normally of the builder and a few tradesmen and labourers.
- The builder himself is concerned with the planning, supervision and execution of all work done by the firm.
- Little or no delegation is exercised and communication is direct between the contractor and the employer.
- There is very little specialisation of functions as the builder will undertake all matters himself / herself, for example, planning, accounting, personal matters and the supervision of the construction.

2.2.2 Medium Firms

- In the medium size firm the owner or manager of that building firm concentrates on the management and delegates the responsibility of supervising the works to a foreman.
- Communication on site will be between the foreman and the architect.

2.2.3 Large Firms

- The builder can no longer be concerned with the detailed supervision of the sites. This is due to the firm undertaking large and many contracts.
- His main concern would be the general development and expansion of the firm.

2.3 Methods of Obtaining Business

We will now discuss the steps to obtaining business.

2.3.1 Speculation

- Risking the firm's own money to build houses, flats, or even factories for sale to an estimated demand. From the profit made, more stands can be bought and more speculation property can be build and sold.

2.3.2 Recommendation

- By a satisfied customer to his acquaintance. Builders who specialise in alterations and extensions normally find work by this manner.

2.3.3 Reputation

- Some firms can reply upon their name for good service and quality built up over a long period of time. Good work advertises itself. Builders who have no comebacks are usually so high in demand that they even have to turn down some job offers.

2.3.4 Arrangement

- Standing agreement with chain stores, banks and other nation-wide companies to erect all their new premises, or with an organisation who sells a design and construction service for specialised plants or council houses.

2.3.5 Negotiation

- The employer comes to an agreement with a builder who has worked for him before, especially when considering an extension to the previous project.

2.3.6 Tender

- Competing with other builders by submitting a quote. This is the estimated price and shortest construction time. It is usually based on bills on quantities. Various tender methods include the Open Tender, Selection, Invitation, Request, and the Negotiated Tender.

- Tender envelopes are not opened before the stipulated time. The lowest or most advantageous tender is accepted.
- Once a selection has been made, only the successful tenderer must submit the fully priced bills of quantities. It is presented to the quantity surveyor for checking. (The tenderer will rectify minor calculation errors. Nonetheless, this adjustment must be done without changing the total tender amount. Serious blunders will cause the tenderer to lose the tender to the second selected on the list.)
- Once the quantity surveyor's report is received, the employer will be informed and, if favourable, the contract will be drawn up and signed by both, the **employer** and the successful tenderer – from now on called the **contractor**.

2.4 The Contractor's Head Office

We will now discuss the departments of a building firm.

2.4.1 Contracts

- The department accountable for contracts is responsible for the handling of contract documents, the negotiation, compiling and signing thereof. Its personnel must study the tender and contract documents before a tender is submitted or the contract is settled. They deal with all legal requirements.
- Contracts with sub-contractors are dealt within this department.
- It is also part of this department's duty to canvas for business for marketing the firm or to solicit business and to investigate the market.

2.4.2 Estimating

The department responsible for the estimating will be employed with the estimating of projects that are being tendered for. Estimating is defined as the determination of the probable cost of the works. The quantity of the different operations is multiplied by the rate per unit of measurement known from recent work.

The estimators receive the basic rates for the necessary items from the costing department. These rates have to be reconsidered and if necessary adjusted to fit that particular project that they presently tender for. Factors such as travelling distance to the site or the availability of some materials and labour may influence the prices.

Estimators must carry out pre-tender investigations about the situation of the site, the availability of material and labour and everything that may influence the cost and construction time.

The estimating department will primarily submit the total tender amount for the project. This amount has to be filled in on the form of the tender.

From this fairly rough total estimate derived from the main items for each different trade the estimators must work out final unit prices to be able to furnish the bills of quantities with rates if the firm was the successful tenderer.

After the quantity surveyor has checked the priced bills of quantities the estimator will make the necessary adjustments before it becomes a legal contract document.

The majority of tenders are yet not won and therefore the estimating department is continuously busy preparing new tenders.

2.4.3 Costing

The cost clerks are constantly busy recording the actual costs of parts of work that is completed. They compile cost sheets with all expenditure regarding the involved labour, plant, transport, material etc. Costing is thus the systematic recording of the real cost.

It is in this department where it is established whether the firm made a profit or loss doing a certain job. A successful firm will have an efficient costing department that will detect possible problems and losses already during the construction periods and will be able to suggest other means and methods to continue the work more profitable. Hence costing is not only the calculation and recording of the eventual cost, but also to analyse expenditure.

A data bank with standard unit prices is prepared and kept up to date. Similar items may have more than one rate depending on circumstances. For example, the fuel price may influence the cost of work in the countryside in a different way as work to be done near a harbour.

These basic rates must be available for the estimators when they prepare tenders.

2.4.4 Buying

In the department responsible for purchases the necessary quantities of materials will be calculated. The bills of quantities may be taken as a basis to work from. However, these quantities have to be processes. The reason for that is that most items in the bills include the labour and more than one type of material.

Concrete, for example is given in cubic metres as placed in position. The buyer still has to calculate the quantity of stone, stand and cement. To that he has to add a certain amount of wastage. Furthermore, he must take into consideration that variation orders could have been issued in the meantime.

The buyers must shop around for best prices, quality and delivery services.

The materials must be ordered well in advance and follow up procedures have to be followed. Materials must be ordered in practical quantities and at constant intervals. Such orders are referred to as progressing orders.

This department is also in charge of the purchasing, hiring, leasing and selling of equipment, tools, plant and machine.

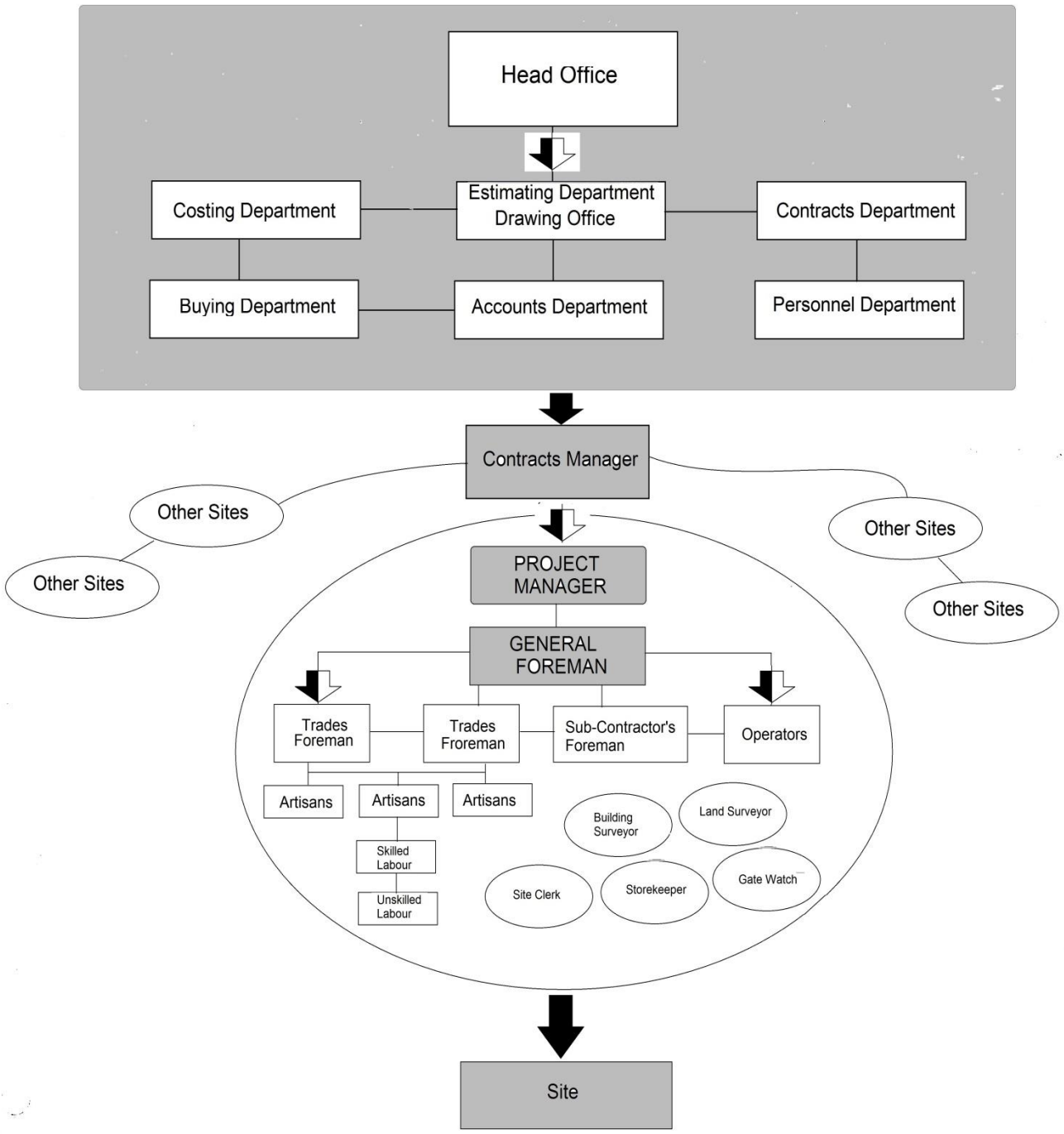


Figure 2.1 The Construction Team of a Building Project

2.4.5 Accounts

- The accounting clerks must pay the invoices from the suppliers of material and equipment and the claims from sub-contractors.
- They have to compare the original orders with the delivery notes and the invoices.
- They must make sure that they receive receipts after payment and must have a proper filing system for those receipts.
- The accounts department furnishes the costing department with the actual expenditures for material and equipment.

2.4.6 Personnel

- The primary function of the personnel department is the recruitment and appointment of staff.
- If caters for the welfare and promotion of the personnel. In-service-training is a factor that is considered important today.
- Subsidy and housing schemes have to be administrated. It has to be ascertained that each employee receives his/her wages or salary at the appointed time and place.

2.5 The Organisational Structure on a Building Site

We will now discuss the organisational structure on a building site.

2.5.1 Contracts Manager

- The link between the main office and the various construction sites is the contract manager. He has to co-ordinate equipment and labour that has to be shared between the various sites.
- Large firms have a central material store. The contract manager will assure that supply from this store will flow without any problem.

2.5.2 Project Manager

- He links between the builder's main office and the site and has the overall responsibility for the site operations. He is the contractor's on-site representative and is accountable to the architect and the engineers. Medium size projects, say to build a school, can do without a project manager.

2.5.3 General Foreman

- He is in charge of the site and is responsible for the smooth running of the construction.
- Small and medium size projects, which do not need a project manager, will need the general foreman to also liaise with the head office of his firm.
- In this case the general foreman supervises the works. He will be the contactors on-site representative who will be the link between the site and the professional team.

2.5.4 Trades Foreman

- Each trade must have its own foreman, the trades foreman. He heads the team, for example the bricklayers.
- The general foreman will consult and instruct the trades foreman only. He will not interfere with the workers of that team.

2.5.5 Artisans

- An artisan is a qualified tradesman and does the actual construction work with the help of apprentices, operators, and labourers.

2.5.6 Labourers (Operatives)

- Labourers work under the command of the tradesmen. Apprentices are workers who are still in training to become artisans themselves one day. Skilled labourers are workers who are used to assist in a certain trade and are able to do basic routine activities, but who have no formal trade's education.
- Unskilled labourers are workers who can do all the bulk jobs which do not need much skill such as excavating trenched, placing concrete and carrying materials. These are normally the casual workers who are hired on a daily basis according to the need.

2.5.7 Operators

- The operators who drive cranes and each moving plant or who are in charge of generators etc. work either under a supervisor or under a specific trades foreman who co-ordinates all the plant activities.

2.5.8 Sub-Contractors

- A sub-contractor is a firm who specialised in a certain trade and who will work independently. The general foreman will assist him, which is called attendance.

2.5.9 Building Surveyor

- He is the counterpart of the professional quantity surveyor and may even be a qualified quantity surveyor who only works as the building surveyor when employed by a construction firm.
- He prepares the monthly claims and sees to it that variation orders are issued and valued for inclusion in the final account.

2.5.10 Surveyor (Land Surveyor)

- He finds the pegs and levels of the premises and sees to it that the building is set out correctly. Where large amounts of earth have to be moved he helps with the calculations for an economic approach and supplies levels for the excavation profiles.

2.5.11 Site Clerk

- If the site is too big the project manager or general foreman will not be able to cope with all the administrative work in the site office.
- Then the site clerk will keep a diary, progress chart, drawing register, files with site minutes, variation orders, and site instructions and so on up to date.
- The site clerk is an employee of the contractor whereas the clerk of works represents the architect/employer.

2.5.12 Storekeeper

- The storekeeper has to record all material that comes into and leaves the storage areas and store rooms.
- He is the key to avoid wastage and theft. He will know when the basic bulk material runs short and must be ordered from the central depot or from the suppliers via the buying department.
- If it is not done by the general foreman, he could be the person who takes delivery of incoming materials, checking them and signing the delivery notes.

2.5.13 Gate Watch

- Nowadays all entries must be monitored, not only to safeguard the public not entering a dangerous construction site, but also to keep all criminal elements outside.
- The gate watch will record all visitors' names as they enter and will sign them off as they leave.
- Casual workers may be checked whether they did not take anything with them that does not belong to them as they leave the site.

2.6 The Building Contract

After the tender is accepted and the necessary contract documents are signed, the builder will be referred to as the contractor. For the builder, works the buyer who places all orders in good time for the material and plant. The personnel department has to see to it that sufficient labour and controlling staff is employed.

One site the general foreman is in charge of all construction. Under him trades foremen are in charge of particular groups of artisans, apprentices and skilled and unskilled labourers.

After a lapse of time the building surveyor will claim an interim payment from the client (employer). The quantity surveyor, who is an advisor of the employer, has to check the claim by valuating the work done to date. The architect has to certify this valuation before payment can be made.

At frequent intervals the costing clerk analyses actual costs of all work done. The estimator of the building firm uses these actual rates when tendering again for new contracts.

Activity 2.1

1. Prepare a diagram of the organizational structure of a building firm with its head office and one of its construction sites. Show and connect the departments and persons of this firm with lines to indicate the flow of the work.
2. Write down the main duty of each of the following departments or members of a medium-sized building firm:
   a) Contracts
   b) Estimating
   c) Costing
   d) Buying
   e) Accounts
   f) General Foreman
   g) Trades foreman
   h) Artisan
   i) Labourers
   j) Personnel management
3. Briefly describe the activities of the following departments or sections of a building firm:
   a) The contract department
   b) The estimating department
   c) The costing department
   d) The buying department
   e) The personnel department
4. Discuss the following methods by which building firms can obtain opportunities to tender for work:
   a) Rotation
   b) Selection with negotiation
   c) Invitation
   d) Request
   e) Open tender
5. Name and describe:
   a) TWO methods of competitive tendering
   b) ONE method of non-competitive tendering
6. Name the document which is used to hand in the quotation when tendering.

Self-Check

I am able to:	**Yes**	**No**
• Describe and explain the building company / firm to include but not limited to:		

o Small		
o Medium		
o Large		
• Describe the methods of obtaining business to include but not limited to:		
o Speculation		
o Recommendation		
o Reputation		
o Arrangement		
o Negotiation		
o Tender		
o Open-tender		
o Closed-tender		
o Negotiated tender		
o Rotation		
o Request		
o Tender procedures using BOE (Bills of Quantities)		
• Explain and discuss the contractor's head office to include but not limited to:		
o Contracts		
o Estimating		
o Costing		
o Buying		
o Accounts		
o Personnel		
• Explain and discuss the organisational structure on a building site to include but not limited to:		
o Contracts Manager		
o Project Manager		
o General Foreman		
o Trades Foreman		
o Artisans		
o Labourers		
o Operators		
o Sub-contractors		
o Building Surveyor		
o Surveyor		
o Site Clerk		
o Storekeeper		
o Gate Watch / Security		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 3

Site Organization

Learning Outcomes
On completion of this module as a learner you should be able to:

- Discuss and explain the function of the site layout
- Describe the importance of access roads
- Explain and discuss the location of major plant on a building project
- Describe the importance of storage areas
- Discuss and identify accommodation needs on a building site
- Describe and explain the site clearing with respect to:
  - Clearing vegetation
  - Soil and earth
  - Structures and buildings
  - Drainage
  - Adjoining property
  - Protection orders
  - Site signage and boards
  - Temporary services
  - Site security
  - Hording
  - Walkways

3.1 Introduction

Before work is commenced on the site, the contractor must consider various preliminary items which will influence all future operations.

The architect's or draughtsperson's site plan has to be studied and careful attention must be paid that no temporary structures are planned in the way of the proposed building.

There is no standard ratio between the free site space required to construct the building and the total size of the site on which the building is to be erected. Each site must be considered as a separate problem in terms of allocating space for people, materials and plant. To obtain maximum efficiency, there is

an optimum laying out the site. An efficient site layout will be reflected in the progress and profitability of the contract.

Room must be allowed for access and proper entrances to the entrances to the site and for the site and for movement on the site. Sufficient space must be allocated for storage; keeping in mind that multi-handing of material must be reduced to minimum.

Temporary accommodation such as the site offices should be situated near the gate overlooking the whole project but noise levels must be taken into consideration.

Plant such as cranes should be based at optimum site coverage with minimum hindrance to and from other activities. The temporary services, such as electricity, water and telephones should be tied in with the future permanent connections to the site.

For safety of the public safety signs and boards have to be erected around site.
If the construction will take place within three meters of the public area, covered wall ways must be erected along the entire border.

All these items are covered for payment in the bills of quantities under the section 'Preliminaries' ('P&G's' from 'Preliminaries and General items').

3.2 Site Layout

Part of contract planning is the planning of a functional site layout. One has to plan around the proposed structure between the boundaries of the property and has to prepare a site layout plan. Such a well-planned layout plan is absolutely indispensable when establishing the site.

Several major decisions 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 FIVE groups, although they overlap to some extent:

1) The provision of adequate access roads for the transport of material and equipment onto and about the site.
2) The location of the spacious and important plant, such as tower cranes, batching plants e.tc.
3) The allocation of areas for the storage for materials
4) The positioning of site huts, such as offices, tool rooms: change rooms, etc.
5) Various ancillary arrangements such as the provision of a hoarding, arrangement with the local authorities for the provision of roads, power and water etc.

3.3 Access Roads

Access to a site is important because often it can be linked to the progress of the construction. The number of access points should be limited. It improves the management of the construction.

Building sites in large cities, densely populated areas and/or very busy streets may need the approval of the local authorities for the servitudes for access.

When planning access roads, keep the following in mind:

- Do not duplicate the public roads. See what is available, and if possible and necessary rather upgrade those.
- Are the access roads suitable and big enough for all vehicles and p1ant, which have to be moved onto the site?
- These roads may not hinder the normal traffic outside, or the construction on site.
- Try to plan two gates, one entrance to and one exit from the site. This will ensure a one-way route and vehicles do not have to make U-turns.
- Plan early for traffic controls and huts for gate watchmen.
- Consider proposed service pipelines, excavations etc. Avoid passing them if possible.
- Accesses should be from secondary roads and not from the main street.
- When planning the type and durability of access roads, one should make an estimate of-the amount of trips that will be made.
- Consider the maintenance that is needed for those roads.
- Do not only consider the traffic caused by the own firm, but also by the delivery vehicles of the non1inated suppliers and other traffic by sub-contractors and consultants.
- Be careful not to harm the environment unnecessarily.

3.4 The Location of Major Plant

The concrete mixing plant, conveyor belts scaffolding, hoists etc. should be positioned where it will cause the least hindrance to the construction, whilst providing the best service. On the other hand, it must be prevented that the, adjacent construction work obstructs the work and movement of the plant.

If for example a tower crane is to be static mounted, it requires a basis for its tower, which needs to be located where it will not obstruct the work on the foundations. If a crane is positioned within the building it should be at a point where the tower will cause the least hindrance to the work that is progressing around it.

The lift shaft of the high rise building could be such a point. It must also be where it will give a radius to cover the most important parts of the building and to all the required lifting or picking-up points.

When planning the location for the major plant, keep the following in mind:

- The choice of the plant may depend on the locality of the site and the space available.
- As far as possible, utilise the contractor's own equipment.
- Try to establish a practical permanent position so that the plant has not to be moved during construction.
- Noisy plant is best stationed far away from the site office.
- They may not be placed too near to any excavations and must be stationed on level and firm soil.
- Mobile plant needs roadways for its activities.
- Plan according to the interaction between the various types of plant. There might be a logical sequence of activities and certain plant may only be required at a later stage.
- Shelter it from the public. Think of theft and vandalism.
- Remember that most plant depends on an electricity and water supply. These temporary services should be nearby. Long connection lines are costly and are easily damaged.
- Operators must have a clear view when operating the plant.
- Also consider the installation regulations and the safety of the workers.
- After completion of the structure, is there enough space to dismantle and remove the plant?
- Do we have access for maintenance?
- Consider the boundaries of the property and the neighbouring properties. For example, the jib of a crane should not move across public areas or private property.

3.5 Storage Areas

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

The most common bulk material are bricks, cement, concrete aggregates, precast concrete units, timber and reinforcing steel. If any of these 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 use of detailed method planning it is possible to minimise storage areas.

Doub1e or multi-handling of material should be avoided. It requires extra expenditure for unnecessary labour and vehicles, and material gets easily damaged and wasted. Keep the material at the most practical spot, nearby where it will be needed eventually.

Cement and aggregates should be stored where it can be fed directly by road transport and yet near enough to the mixing plant.

When planning the location of the storage areas and sheds, keep the following in mind:

- Materials must be stored according to various special needs. It must be sheltered against damage, wastage and theft. Different types of material need different facilities.
- Place storage areas as near as possible to the site offices to ensure better monitoring.
- Place them near the gate to ease deliveries. But be careful to place car parks away from delivery and storage zones to hamper pilferage.
- Allow for enough off-loading space for the delivery vehicles.
- One could easily forget-the needs of the sub-contractors who need lots of storage and preparation space. Plumbers must store long lengths of pipes. Steel fixers need to layout long lengths of reinforcing steel and steel mesh.
- Consider the sizes and amounts of the expected materials.
- Use the space in completed structures and build covered walkways strong enough to use its decks for storage.
- Incorporate accommodation for the storekeeper. Plan storage in a way to allow the storekeeper to oversee everything and to monitor deliveries from suppliers and hand outs to the workers on site.

3.6 Accommodation

The location of site offices and sheds is dependent upon the individual site requirements. They should be easy reachable from the gate as from the project. The supervisors would appreciate a location where the works can be viewed from the window.

Choose from portable (complete units transported on trucks), mobile (caravan type), framed (steel framed with cladding) or sectional (prefabricated sections) accommodation.

When planning the location for the site offices, keep the following in mind:

- Think of all the needs, an office for the foreman, the clerk of work, the building surveyor and for site meetings, a change room, kitchen, first-aid etc. The location should be near the gate and the parking area to monitor visitors.
- It should be near the stores to be aware of deliveries.
- But one is tempted to go overboard. Use as little space as possible. A. confined site is difficult to manage. Save space for free movement.
- Site huts should not be in the way or any traffic, construction activities or even the actual project.
- Find the best spot to be able to overlook the site.
- Avoid placing the temporary offices too near to the action where lots of noise and dust will interrupt conversation, meetings and telephone calls.

Workshops are for the pre-fabrication operations, for example, carpentry, plumbing, per-cast concrete, or for plant and equipment, repairs and maintenance.

Factors affecting their location include:

- Proximity to site services
- Ease of access for plant and material
- Proximity to office accommodation and surrounding buildings in respect of noise, fumes and dust
- Space availability
- Effect on the smooth flow of the traffic on site
- Needs of the sub-contractors

3.7 Site cleaning and clearing

This may involve the grubbing out of bushes and trees; the removal or topsoil to reduce levels and the demolition of existing buildings.

3.7.1 Clearing Vegetation

One of the first operations on site is the clearing away of rubbish, grass, shrubs and trees not affected by preservation orders. The method of removal will depend on their size and the equipment available to the contractor. The methods available are:

- Pushing large trees over and out by means of a bulldozer
- Digging them out by means of a suitable mechanical excavator
- Pulling them out by means of a chain wrapped around the tree and attached to a mechanical pulling device
- Burning down grass, provided it is allowed in that area and that suitable precautions are taken
- Cutting down shrubs and small trees by an axe or chain saw
- Chemical destruction by boring holes into the trunks of the trees and pouring in chemicals. This, of course, is long-term solution. Weed killers could be used on grass. But use caution as it may make future gardening impossible.

3.7.2 Clearing soil and earth

Topsoil is valuable as top dressing for gardens. It is stripped from the site before site development and excavation work proceeds. If it is described to be preserved for later use, it is stockpiled on the site.

3.7.3 Structures and buildings

Demolishing of existing buildings is a skilled occupation and should only be tackled by competent contractors or sub-contractors. Safety is the all-important factor and applies not only to the work force but also to the general public, adjoining property and services.

There are two types of demolition: total and partial. Total is where the whole structure is demolished. Partial is where only part of the structure is removed, either internally as for alteration works, externally as for a face-lift, or a combination of the two.

The work should be programmed well and is generally carried out in the reverse order to that of the building's construction. The debris should only be allowed to fail freely to the ground internally. It may fall externally where there is no risk of damage to the public or to private, property. Special gaze curtains must be attached to the outside of the building if it is a number of storeys high.

The methods of demolition depend upon the type, size, state and position of the building in question:

- By hand, using sledgehammers, chisels, picks and crowbars or with small powered tools like pneumatic drills and breakers. This method is suitable for confined sites, internal work, or where there is valuable material to be reclaimed.
- Fragmentation is the process of reducing the building to a heap of rubble. This can be done by a cast-iron or concrete ball, which substitutes the bucket on an excavator and is swung against or dropped on the structures. Small structures can be pushed over by bulldozers or pulled by a wire hawser attached to a tractor.
- Large structures are often demolished by implosion, which is an inward explosion where all the rubble falls to the inside. The use of explosives is restricted to specialists holding the necessary licenses. Before blasting, the police should be informed so that traffic may be kept at a safe distance.
- The local and service authorities should be informed so that they are aware of possible damage to their facilities which may be caused by shock waves. Blast mats should be used to protect surrounding properties from shock, vibration and flying debris.

3.7.4 Drainage

Rainy seasons and sites with a high water table will require some form of subsoil drainage. The water table is the level at which water occurs naturally below the ground and this level will vary with the seasonal changes. If basement excavations reach below this point permanent baling and pumping must be done until the construction has reached ground level.

3.7.5 Adjoining property

Many sites abut or are surrounded by other buildings, and it is important that good relations should be maintained with the owners of these properties right from the start.

Put the neighbours in the picture as to what inconveniences to expect in regard to dust, noise and so on. It is practicable to insure against mishaps and

suggested damage to existing property. (Temporary support to such buildings must be designed by an engineer and is part of the actual construction work.)

3.7.6 Protection orders

In order to maintain a country's heritage, natural and man-made features of interest or beauty should be preserved. Relevant impact studies are usually done beforehand by the professionals who are engaged by the employer.

Legislation protects certain plants and environments. The precise area and ways of preservation will be stipulated in the contract documents and the contractor will be compensated for his effort.

There are even listed historic buildings that may not be altered in any way without the permission of the relevant preservation body. In these cases the contractor has to work strictly according to the regulations.

In fact, he should welcome constant inspections, which uncover problems at an early stage; because the contractor is bound to pay a fine if he in any way removes, damages or replaces any part of it without the proper authorization. This is not the building owner's liability since the contractor took temporary possession of such structure.

3.7.7 Site Board

The sign board with the names of the main parties involved in the project should be clearly displayed, remembering that this is an advertising aid. Casual labour, subcontractors, suppliers and visitors must have no difficulty in finding the site. In country districts the use of direction boards is very helpful in directing people and suppliers to the site.

3.7.8 Temporary services

Wherever possible, the provision of temporary services should be tied in with the future permanent service connections.

The temporary service lines from the existing or never permanent service locations should be as short as possible.

Early consultation with the statutory authorities can avoid later expenditure and frustration when the works on site have begun.

Consider the following service lines:

- Drainage
- Storm-water drainage
- Electricity
- Telephone
- Water

3.7.9 Site Security

The loss of material and goods such as tools and equipment is a real problem on sites now-a-days. Theft of materials is discussed in Module 5. Except effective hoardings, lockable gates and secure storage, the South African contractor must also invest in other measures. Accommodate an exterior professional security firm to patrol the site.

Vandalism is another problem to cope with. This is usually perpetrated by outsiders rather than by the employees. Completed sections have to be fenced off or locked and must be watched 24 hours a day.

Injury to employees and the public require barriers according to regulations.

3.7.10 Hoarding

Hoarding is a temporary closed type of high site enclosure, to mainly prevent theft and injuries to the public. Other site enclosures are mesh fencing and palisades. The contractor is responsible to erect a hoarding before excavations start and has to remove it before the project is handed over to the owner after completion.

Hoarding: a temporary fence of boards, for example, round a place where a building is being knocked down or built.

Requirements regarding a hoarding:

- It must be high enough to prevent intruders: between two and three meters high.
- The standards of the framework must be properly secured into the ground.
- The planks or sheeting must be fixed to a strong framework.
- Timber planks must have a minimum thickness of 25 mm and metal sheets must be at least 10 mm thick.
- No sharp points, such as sticking-out nails, may project on the side of the street.
- No gaps are allowed between the planks and the sheets, except for gates and proper peepholes for the public to watch the project as it develops.
- Openings for gates are not to be more than one for every 15 m of length.
- Gates must either open inwards or must be of the sliding type. (If possible, entrances should always be in the least busy street.)
- If material is to be placed on the building site against the hoarding, the framework must be on the outside of the site. This means that material may only be deposited against that side of the sheeting where no framework can be seen.
- The hoarding should be able to withhold a wind force of 750N/m at a height of 1,25 m above the ground.

- Local authorities may have regulations concerning the hoarding. The contractor has to find out about that and has to erect the hoarding accordingly. Often he heeds the permission of the municipality in question.
- Hoardings must be inspected at regular intervals and especially after fierce winds and rainstorms.

3.7.11 Walkways

Walkways are new or adjusted paths for the public when existing pavements around construction sites are not save.

- **Temporary Walkways**

If the construction exceeds into the public area and less than 1,5 m would be left of the pavement, the contractor must erect a new temporary walkway.

The contractor must first obtain the permission of the local authorities to build these temporary structures on the municipal property. He / she must make sure that the flow of the traffic is not interfered with; otherwise he / she must arrange detours. Standard road signs must be used.
Temporary walkways must be at least 1,25 m wide and must have guardrails. For split levels ramps must be, used instead of steps.

The walkways must be checked and repaired regularly and must stay in position for the full duration of the contract period. After construction, the walkway must be removed and the pavement must be cleaned to be in a condition as found.

- **Covered Temporary Walkways (Gantries)**

Temporary walkways must be covered to prevent falling objects onto passer-by's if the construction or the demolition takes place within 3 m from the border of the property.

The covered walkway must be erected along the entire length of the border and must be kept in position until all external work is completed.

The planks or sheets, which form the roof of this walkway, must be fixed without any gaps so that no debris can fall through it. A rail should be attached to the roof preventing accumulated debris to fall off.

- **Storage on Top of Covered Temporary Walkways**

In cities construction sites are often confined and the roofs of temporary walkways offer valuable space for site offices and storing building materials.

Strict safety regulations have to be applied when such walkways are constructed. It must be constructed with heavy up-right supports and beams, slightly inclined towards the site.

The platform or roof must be securely nailed to the framework, may not have any gaps and must have a guardrail to prevent n1aterial from falling off The load must be tighten down and must be monitored by a responsible person. A competent person has to inspect the covered walkways at regular intervals and during and after inclement weather conditions.

Activity 3.1

1) Describe the erection or demolishing of buildings, on each of the following:
   a) Temporary walkways.
   b) Covered walkways.
   c) Storage of material on top of covered walkways.
2) Explain what has to be considered when planning the site layout for the following:
   a) Location of major plant such as cranes and mixing plant.
   b) Storage areas.
3) During major construction work or demolitions the contractor has to erect a temporary fence around the site.
   a) What is this closed fence called?
   b) Name NINE (9) important rules regarding this fence.
4) A building site has to be established. What important considerations have to be taken into account when planning to incorporate the following:
   a) Access roads.
   b) Plant and machines.
   c) Site offices.
   d) Sheds and storage areas.

Self-Check

I am able to:	Yes	No
• Discuss and explain the function of the site layout.		
• Describe the importance of access roads.		
• Explain and discuss the location of major plant on a building project.		
• Describe the importance of storage areas.		
• Discuss and identify accommodation needs on a building site.		
• Describe and explain the site clearing with respect to:		
o Clearing vegetation		
o Soil and earth		
o Structures and buildings		
o Drainage		
o Adjoining property		
o Protection orders		

o Site signage and boards		
o Temporary services		
o Site security		
o Hording		
o Walkways (Temporary and Covered)		
o Storage on top of covered temporary walkways		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 4

Building Tools and Equipment

Learning Outcomes
By the end of the module you as a learner should be able to:

- Explain and discuss Small powered plant equipment
- Discuss and describe the most commonly use hand-held electric hand tools
- Explain and use pneumatic equipment
- Discuss the machinery in a timber workshop
- Draw up a flow chart of activities in the joinery workshop
- Discuss foreman's challenges and problems relating to a construction site and a workshop

4.1 Introduction

In this module we will discuss and describe the building tools and equipment that is used on a building project.

4.2 Tools and Equipment

We will discuss the tools and equipment that is used on a building project.

4.2.1 Small Powered Plant

Most hand-held power tools are operated by electricity or by compressed air either to rotate the tool or to dive it by percussion.

Generally pneumatic tools are used for heavier work. They have the advantage that they will not burn out if a rotary tool stalls under the load.

Electricity driven tools are relatively quiet since there is no exhaust noise. They can be used in confined spaces because there are no exhaust fumes.

4.2.2 Electrical Hand Tools

The most commonly used hand-held tool is the electric drill for boring holes into timber, masonry and metals using twist drills. The impact-drilling machine (rotary hammer) is very useful for the plumber to drill holes through walls for pipes etc. It has a hammer action

The angle grinder can be used for cutting metal. It is also used to chase into brickwork at an angle at the gables.

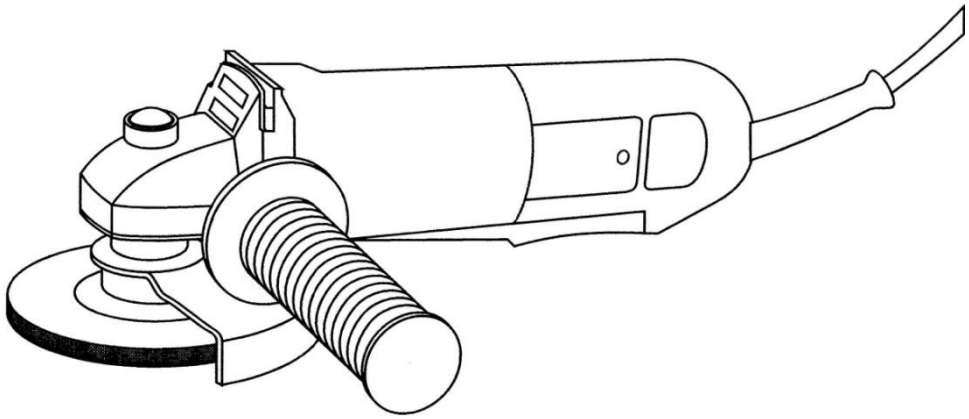


Figure 4.1 Angle grinder

The electric screwdriver has an adjustable and sensitive clutch that will only operate when the screwdriver bit is in contact with the screw head. It will slip when a predetermined tension has been reached as the screw has been driven in.

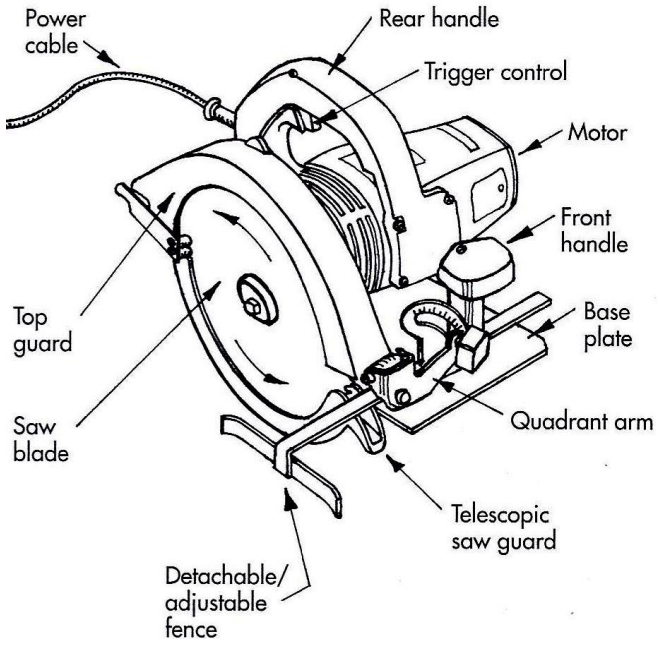


Figure 4.2 Portable circular saw

More portable electric tools for available and suitable for site use:

- Circular saws (skill saw) for cutting timber across and along the grain – see **Figure 4.3.**
- Jig saws to cut out patterns – see **Figure 4.5**
- Planers for smoothing and shaping the wood by shaving off layers
- Sanders for cleaning up the wood and smoothing it to even finer limits as with a planning machine, also available for fine finish plaster
- Routers, which are used for cutting out mouldings and recesses for hinges and lock mortises when hanging doors.

Figure 4.3 Using a circular saw

All these tools should be earthed unless they bear the 'two squares' symbol indicating that they are "All Insulated" or "Double Insulated" and therefore have their own built-in safety system.

Protective guards and any recommended protective clothing such as goggles and ear protection should be used as instructed by the manufacturers.

Electric power tools must never be switched on/off whilst under load since this could cause the motor to become overstrained and burnt out.

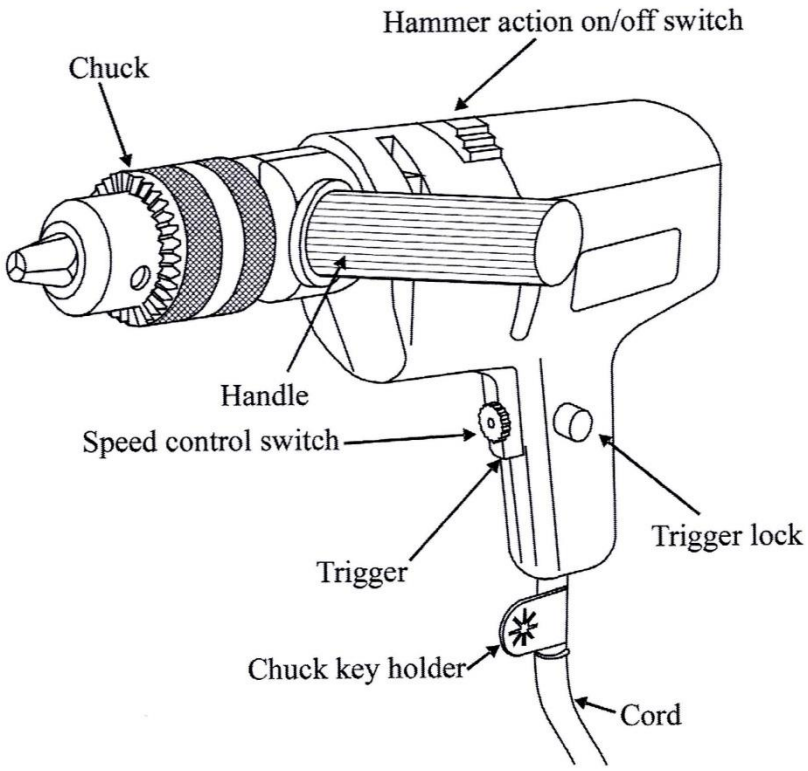


Figure 4.4 Portable drilling machine

Figure 4.5 Portable jig saw

4.2.3 Pneumatic Equipment

These tools need a supply of compressed air for their power source. On building sites this is generally in the form of a mobile compressor powered by a diesel engine. Petrol or electric motors may also be used as power units.

One of the most commonly used pneumatic tools in construction is the breaker/jack hammer. It is basically intended for breaking up hard surfaces

such as concrete slabs. A variety of breaker points or cutters can be fitted into the chuck of the breaker or tackle different types of surfaces. A chipping hammer is a small lightweight version of the breaker.

Backfill tampers are used to compact the loose spoil returned as backfill in small excavations.

Other equipment which can be operated by compressed air include vibrators for consolidating wet concrete, small trench sheeting or sheet pile driving hammers., spraying equipment and hand-held rotary tools such as drills, grinders and saws.

Figure 4.6 electric screwdriver

Pneumatic tools are generally very noisy.

4.2.4 Examples of more tools and equipment

Cartridge hammers/guns are used for the quick fixing together of components or for firing into a surface a pin with a threaded head to act as a bolt fixing.

Poker vibrators are immersed into the wet concrete and due to their high rate of vibration they induce the concrete to consolidate.

The effective radius of a poker vibrator is about one meter; therefore the poker should be inserted at approximately 600 mm centers to achieve an overall consolidation of the concrete.

Vibration tampers are small vibrating engines, which are fixed to the top of a tamping board for consolidating concrete paving and slabs.

Clamp vibrators are attached to the external sides of the formwork (shuttering) to vibrate the whole of the casing. Care must be taken when using this type of vibrator to ensure that the formwork has sufficient in-built strength to resist the load of the concrete and to withstand the vibration.

Owing to the greater consolidation achieved by mechanical vibration, up to 10% more material may be required when compared with hand-tampered concrete. Separation of the aggregates can be caused by over vibrating a mix, therefore vibration should be stopped when the excess water rises to the surface.

Vibration of concrete saves time and labour in the placing and consolidating of concrete but doesn't not always result in a saving in overall costs due to the high formwork costs, extra material costs and the cost of providing the necessary plant and power.

Power floats are hand-operated rotary machines with revolving blades or a revolving disc. The objective of a power float is to produce a smooth level surface finish to concrete surface beds and slabs suitable to receive the floor finish without the need for a cement screed. It can also be used to finish granolithic or similar toppings.

The basic function of a pump is to move liquids vertically or horizontally or in a combination of the two directions. Centrifugal pumps are either reciprocating or diaphragm pumps.

Reciprocating pumps work by the action of a piston or ram moving within the cylinder. These pumps have the disadvantage of being unable to handle water containing solids. Displacement pumps of the diaphragm type can handle liquids containing 10 to 15% of solids, which makes them very popular.

They work on the principle of raising and lowering a cylinder. Submersible pumps are used for extracting water from deep wells and sumps and are suspended in the water that is to be removed.

Rollers, compactors and rammers are designed to consolidate filling materials and to compact surface finishing's such as tarmacadam for paths and paving's. They rely either upon deadweight or on vibration to carry out the consolidating operation.

Fuel driving generators are used to supply power on site where no electricity is available.

4.3 Machinery in a Timber Workshop

4.3.1 The uses of Woodwork machines

In a workshop where wooden doors are manufactured, the first machines that are to be used will be a variety of circular saws.

The cross-cut saw is used to cut the long pieces of timber across the grain to the wanted lengths (according to the height and width of the doors)

The second step is to cut the now shorter and workable lengths along the grain into suitable widths with the ripsaw (from 228 x 76 mm).

The planer (surface planning machine) then produces two adjacent smooth sides to the lengths of the timber.

Finally the other two sides are cut according to the wanted sizes by feeding the timber twice through the thicknesserr.

Into the door stiles mortises are cut by the mortise and tenons are formed at the ends of the top rails by means of the tenoner.

The tongues and grooves which are necessary to join the battens are best cut with a spindle moulder, but great care should be taken as these machines are quite dangerous and accidents easily happen because of the extremely high rotation speed. A router could also be used for this activity.

To make holes for screw the pedestal drill is used and after the doors are assemble they are smoothed off with the sander (belt sander).

For sharpening blades each workshop should have a bench grinder which should be placed away from the woodworking activities because of a fire hazard. Furthermore the workshop must have extraction units to suck out and remove the sawdust, shavings and the fumes from the glue and paint spraying.

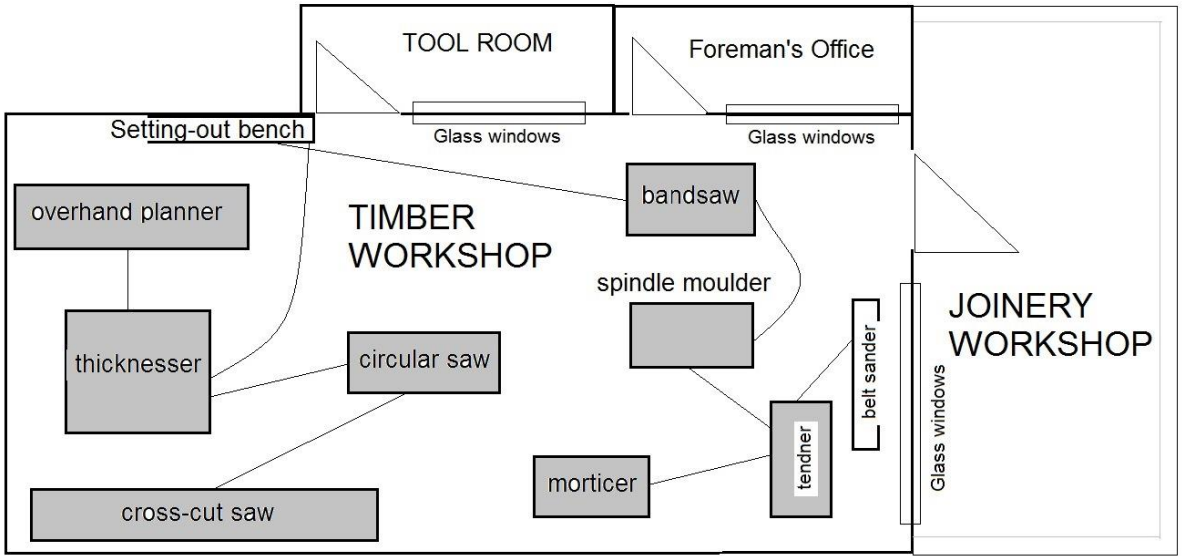


Figure 4.7 Timber Workshop

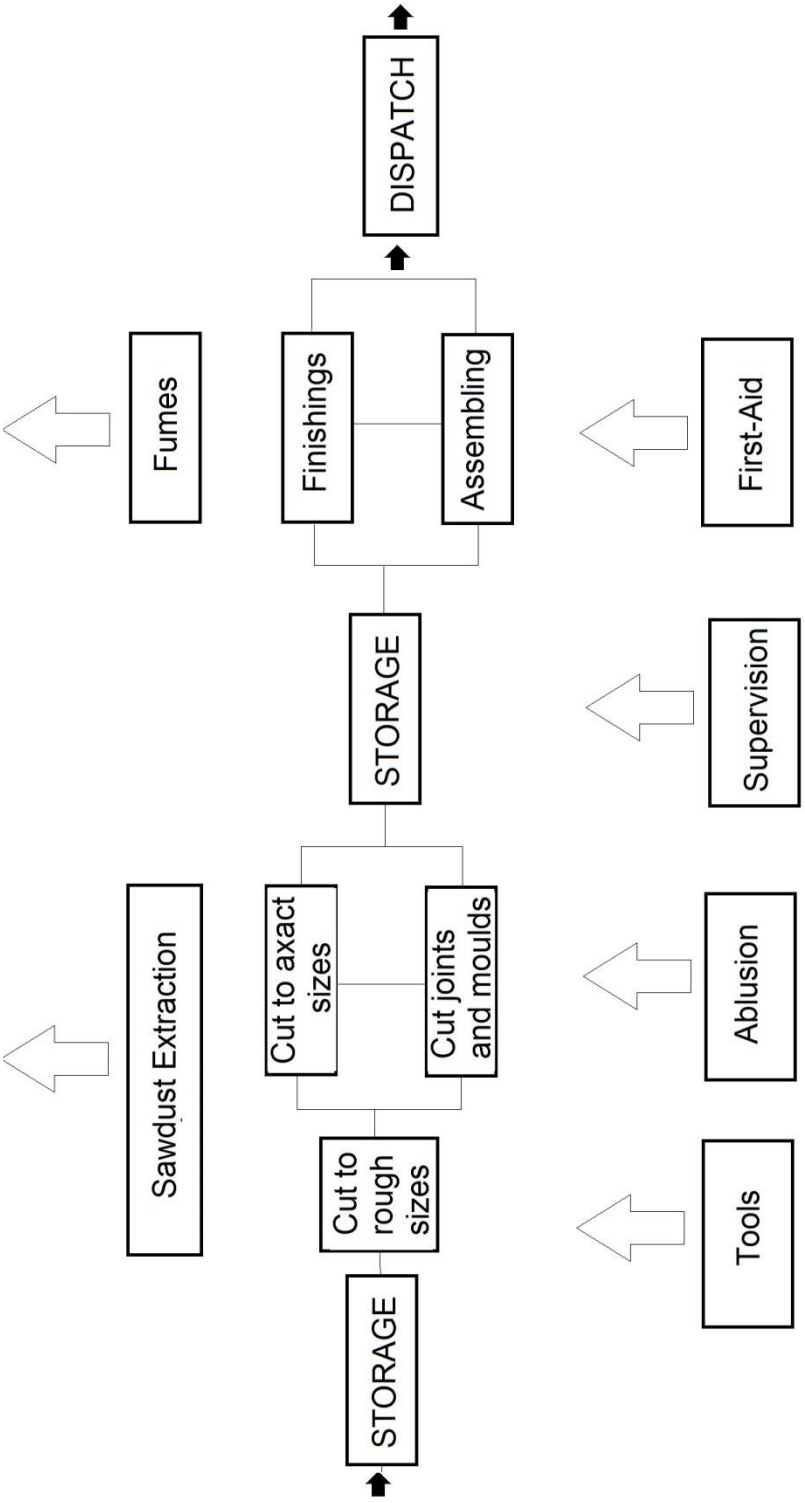


Figure 4.8 Flow Chart of activities in Joinery Workshop

4.3.2 How to arrange machines in wood workshops

First make a proportional sketch of the available space, write down the names of all machines required, transfer the names into the correct positions and then connect them, with arrows to show the flow of work.
Start the layout planning at the entry of the timber store. The machines must be placed in a logical order to give a smooth flow of work. Put machines, which are usually used for related tasks in groups together. If possible, they should be placed in neat rows.

Allow for sufficient working space around and between machines, especially for the long pieces of timber at the start of the operation. Consider the in feed and out feed at the sides of the machines. Remember to allow for enough space for traffic of the workers and material and for the cleaning of the workshop. Also consider maintenance to the machines.

It must later be possible to remove broken and to install new machines. However, the planning should be for a permanent layout; equipment cannot easily be moved later on. Workbenches for setting out may be placed against the walls. Machines that require lots of attention and where accidents easily happen should be placed away from the traffic and away from the doors.

Allow for large storage areas at the entrance, between different tasks and at the dispatch. Consider the electric supply points, if necessary plan for overhead or sealed and hidden extensions, loose wires may under no circumstance cross the floor.

The supervisor should easily overlook machines. The offices could be lifted to have a good view and space below the office can be used as a storeroom for tools and accessories. Very noisy machines are not to be placed near the office.

Attention is to be paid to safety regulations. Grinders, glue presses and spray paint equipment must be places in separate rooms to avoid fires and injuries by harmful fumes. Emergency exits and fire extinguishers are to be included in the plan. Extraction units to remove the sawdust from the cutting are and fumes from the paint area must be included in the layout.

Incorporate a separate first aid room.

4.4 Supervision

4.4.1 Foreman's challenges and problems

The general foreman and the trades foremen, who may well love the outdoors, face completely different challenges that their counterparts, the foremen who supervise a workshop.

Construction Site	Workshop
In the open air the works, the workers and the supervisors are exposed to the elements. For the workers there is no hade, no heater, no roof, and rain and storms could damage the construction.	Work is done under shelter. This provides a healthy and comfortable working milieu. Material and products will not be damaged by rain etc.
During bad weather valuable construction time will be lost. It may put the project behind schedule.	If it is very cold, heaters can be turned on. During the hot summer months the air conditioning ensures constant production.
Rain results in the workers sitting idle. Expensive hired plant cannot work to their maximum capacity while costs keep on running.	The input is constant, time and money is not often wasted because of hold-ups of all sorts.
No project is the same as the previous one. This may make the work very interesting, Ands surely, it must give everybody on site some satisfaction as the project develops. Nevertheless, each project will face new unforeseen problems. Progress and daily output cannot be forecasted as accurately as for a factory.	In a workshop standard items are manufacturer. This could be very boring and could lead to some mischief. But at least, output can be predicted; and there are many management skills to motivate workers.
Construction work is dangerous at times. Because the works vary all the time danger is not always predictable and accidents occur.	Dangerous machines are sheltered from the other machines. They are placed in a permanent position and manned by competent people.
Building firms usually operate in various regions and therefore they have to comply with different local authorities and regulations.	Building firms have central workshops from which they distribute their prefabricated items. Only the National Building Regulations have to be followed.
Working space is dictated by the laout plan of the building. At times as the building grows, the spaces get very confined. On the other hand, when construction only has started, materials have to be carried for long distances on site.	The most practical layout for a workshop can be planned unhurriedly. But once the machines and benches are installed it is difficult to rearrange them.
Communication is a real problem. To be in contact with the outside can be arranged, but to co-ordinate all workers on site requires real effort.	Supervision in workshops is not too difficult, especially if the office is lifted and has glass planes to oversee the work. However, this could be annoying for the workers.
Storing of material is another problem.	Although successful communication

Temporary sheds have to be placed at the best spot available. Everything is dependent on the situation of the proposed building which differs from project to project.	remains a problem in all situations, communication in workshops is easy compared to that on construction sites.
The positioning of excess roads and plant like the concrete mixing plant and cranes is often very tricky. Each site required new planning.	In workshops permanent storing areas can be allocated. It is practical to have at least a storage are for the incoming material, one for the partially completed products and one for dispatch.
Most of the time the people on site are far away from any facilities like shops and recreation centers. It may even be difficult to reach work each morning. When sites are really far away, overnight camps have to be supplied. All this puts extra social strain onto the workers and the supervisors.	Machinery is fixed in permanent positions. Workers get used to the outlay and supervisors do not have to plan new layouts. On the contrary, as the years pass by, the owner of the workshop could add some improvements into it.
As the amount of work is not constant and because each new site is in a different area, the permanent staff has to put up with lots of labour fluctuation. It is almost impossible to build up a loyal work force.	Workers can choose to work in a workshop near their homes. Facilities like washrooms, first-aid rooms, canteens etc. are usually available.
One of the most disturbing factors in building construction is that you must always expect and adjust for variations. This is so because no site or building will ever be exactly the same as the previous one. The designers and planner just cannot foresee everything. The foreman has to be flexible and have to be problem solvers.	Over the time one can build up a competent and loyal labour force and it is possible to have them employed for a long time.
And then of course, there is the disturbing supervision of the employer via the architect and the clerk of works, who is on site permanently. This could mean some interference, and if not so the foreman must always be polite and prepared to accept criticism.	One of the big advantages working in a workshop is that one can stick to the programme because the orders are not often varied.
	A workshop receives it orders from outside and as long as it produces the wanted articles there will be no interference.

Activity 4.1

1. For a workshop where timber doors are manufactured, Draw a flow diagram (in logical sequence) as model layout for the flow of activities and also the various machines.
2. The following questions refer to a workshop where timber doors are manufactured:
   a) Name the use of the following equipment:
      i. Cross cut saw
      ii. Tenoner
      iii. Spindle moulder
      iv. Belt sander
      v. Extraction unit
      b) Give FIVE guidelines to be considered when arranging woodworking machines in a workshop.
3. Make use of a large single-line diagram to show a floor plan layout of a workshop where wooden doors are manufacturerd. Include the following in the layout:
   a) Saws
   b) Finer finishing
   c) Planing and sanding
   d) Workbenches
   e) A glueing machine and assembling press machine
   f) Stoage areas
   g) Room for supervision, tools, first aid and ablutions
   h) An extraction unit (sawdust etc.)
   i) Arrows to show the flow of activities

Self-Check

I am able to:	Yes	No
• Explain and discuss Small powered plant equipment		
• Discuss and describe the most commonly use hand-held electric hand tools		
• Explain and use pneumatic equipment		
• Discuss the machinery in a timber workshop		
• Draw up a flow chart of activities in the joinery workshop		
• Discuss foreman's challenges and problems relating to a construction site and a workshop		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 5

Building Materials

Learning Outcomes
By the end of the module you as a learner should be able to:

- Describe the procurement procedures with reference to:
  - Ordering
  - Follow-up operations
  - Taking delivery and checking
  - Storing
  - Authorizing payment
- Explain and discuss documentation in the supply of material with reference to:
  - Order forms
  - Requisition forms
  - Advice notes
  - Delivery notes
  - Invoices
  - Receipts

- Discuss and explain combined documents
- Describe cutting down on wastages
- Explain and discuss how to prevent theft

5.1 Introduction

The satisfactory supply of raw material is the key to a smoothly running project.
It starts with the careful phasing and planning of the required material.

5.1.1 Procurement procedures

In the pre-contract period, time schedules are already made according to the needs for the various activities. Then the buyers will send enquiries to two or three suppliers or in some cases directly to the manufacturers for such items as aggregates, bricks, and cement etc., regarding prices, delivery dates and such for use at the estimating stage to the project.

This will enable the estimator to use the figures obtained in the preparation of the tender figure. If the builder is then successful in his bid for the work, he / she will place his orders with the suppliers of his choice by comparing the various quotations received.

The architect prescribes the suppliers for the 'Prime Cost Items' and the prices are fixed.

Still, the buyer must place the orders whenever scheduled. Orders must be placed well in advance before the goods are actually needed on site.

Follow-up operations are next. Orders must be confirmed. On a continuous basis progressing orders have to be placed for the bulk materials. Bulk material like bricks, cement, stone etc. should not be ordered all at once but in stages as they are worked up. The buyer must be in total control of this.

Taking delivery: When materials and goods cannot be used up immediately, they have to be stored on site.

Because most materials and goods cannot be used up immediately, they have to be stored on site. Finally material has to be paid for. This is done by head office.

5.2 Procedures

5.2.1 Ordering

Delay of the delivery of building materials causes serious problems. Progress may be held up, other operations may have to wait until the tasks dependent on that particular material are completed and workers may be kept waiting.

- **Follow-up operations**

The buying department which is responsible to order the material must make sure that the delivery will really take place as planned. This procedure is the follow-up operation.

It is very important to order early enough to give the supplier a chance to organize the delivery properly and to son out any problems. When ordering over the telephone, the buyer must keep book of the names of the persons who were spoken to, the date and any particulars about the order. Telephone orders must be confirmed in writing.

The supervisors on site must be informed about the expected deliveries. Make sure that the supplier will send proper advice notes to prepare the receipt (receiving of material).

It is a good practice to confirm an order again a day or so before the delivery is due. This gives everybody enough time to attend to problems end to clear up misunderstandings which slip in easily. Also remind the staff on site.

If the buyer experiences problems with an order or with the people concerned, he must note this down. This is of importance for the next order, problem suppliers must be avoided in future and mistakes must not be repeated.

Late and overdue deliveries need deliveries need special attention and one has to keep working on it until the material has arrived.

Be aware of changes in the design and variation orders. This can cause that the original order has to be adjusted. This must be done immediately. Always record everything you did and what you discussed.

- **Progressing orders**

Progressing orders are usually for bulk material where not the total amount or the full quantity is to be delivered at once but on a regular basis.

The buying department must monitor these orders on a continuous basis. Practical quantities should be ordered. Monitor consumption. Progress on site must be taken into consideration.

Order enough material to keep the work flowing but not too much to get in the way or to get wasted.

Detail programmes are of great value. From these documents delivery schedules with required quantities and delivery dates can be drafted. Forward copies of these schedules to the suppliers and stay in touch with them.

Remember that progressing orders may not be delivered too soon this will generate multi-handling. They may not be delivered too late either; this will cause the work to idle. Keep in touch with the storekeeper. He/ she must know exactly when to expect deliveries.

If any delays in the delivery of materials occur, there will be a delay in the work and the progress of the construction will be affected. It is at the end of the day the responsibility of the general foreman to ensure a positive progress and therefore it is his / her responsibility to also do follow-up orders well in advance.

It will be fatal to blame the buying department or any other party when the project falls behind schedule because of a delay in the supply of material.

5.2.2 Taking delivery and checking

All deliveries must be checked against the relevant documents for shortages or damage and no exceptions should be made. Unloading may be supervised by a storekeeper, site clerk or by the foreman, but a clear routine should be established, particularly on the larger or more open sites.

Haulage tippers with aggregates must be spot checked regularly to ensure that they are loaded to the capacity being paid for. Some material, for example, ready mixed concrete requires quality tests.

Only competent persons may conduct these tests and meticulous records should be kept. Any goods not examined should be marked as such and checked as soon as possible afterwards. Both, the receiver of the goods and the driver of the delivery vehicle must sign the delivery document.

5.2.3 Storing

Store rooms and sheltered areas must be prepared and ready in good time to receive the various materials. The site must be theft-proof and the huts must be clean.

Different material must be stored to different rules. The advice from the manufacturers and suppliers concerning proper storage methods should be studied and followed.

Store in a way in which double handling of the material is avoided. So that the material will not obstruct other activities on site or get damaged or wasted any way.

A competent storekeeper is a necessity and an investment on any' sizeable contract both for the adequate control of bulk stocks and the identification and location of special components and materials.

Storekeeper activities include:

- Basic recording into a record book of receipts from deliveries and issues to the site.
- The operation of minimum re-order levels
- Accounting for returnable packages and empties
- transfers between contracts
- Disposing of scrap
- constant stocktaking
- Annual asset control
- Security arrangements by a watchman or dogs.

Standard procedures should be laid down for the efficient operation of these aspects.

5.2.4 Authorizing payment

Information from the delivery notes and the checkers comments on those delivery notes is later used to verify that the goods charged on invoices have actually been delivered.

Invoices are then compared with the original orders to confirm that correct materials have been supplied at the agreed prices, and can then be authorized for payments.

5.3 Documentation in supply of materials

We will be looking at various documentation for the supply of materials, they include**:**

- Orders
- Requisitions
- Delivery Notes
- Advise Notes
- Receipts
- Invoices

Let us now look at the Order form.

5.3.1 Order Forms

No order should be carried out without the necessary official documents. This is to cut out any possible corruption. Without an order the supplier has no authority to supply the goods and can be denied payment eventually.

Orders are made out in the buying department. Smaller goods like hacksaw blades, drill bits, etc. may be ordered directly by the site clerk. For reference purposes each order should have a chronological order number.

The standard format includes the building firm's name with a postal address where invoices can be sent to afterwards.

Furthermore it is important that the site's physical address will be stated on it, if necessary with some road directions.

Orders are made out in quadruplicate; one copy for the supplier, one copy for the site (to be compared with invoices) and one is retained in the buying department for reference filing.

Figure 5.1 shows a typical order form used for purchasing.

<table>
<tr><td colspan="4">ORDER FORM</td></tr>
<tr><td colspan="2">Company LOGO</td><td colspan="2">Purchase Order Number</td></tr>
<tr><td colspan="2" rowspan="3">Company Address
ABS Building Construction (Pty) LTD
PO Box 30 Bergvliet 7864
Tel: +27 (0) 21 715 6055</td><td colspan="2">PO: 5678</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Date</td><td></td></tr>
<tr><td colspan="4">By accepting this Order you agree to the terms and conditions printed on the back.</td></tr>
<tr><td colspan="2">Please carry out the supply in accordance with your quotation numbered _____and dated _____ as follows:</td><td colspan="2" rowspan="2">All INVOICES, Statements and correspondence related to our Head
Office QUOTING THE ABOVE NUMBER AND DATE</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2">PRICES</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td rowspan="2">Deliver to:</td><td>Commence</td><td colspan="2">For and on behalf of ABS Construction (Pty) LTD</td></tr>
<tr><td>Complete</td><td colspan="2"></td></tr>
<tr><td></td><td>See conditions overleaf</td><td colspan="2">Director</td></tr>
</table>

Figure 5.1 Typical example of an Order form

5.3.2 Requisition Forms

The contracts manager of large firms organizes the supply of bulk materials (cement, stone, sand, etc.) and basic ingredients (nails etc.) to the various sites from one central store. In that case the storekeeper must do constant stocktaking and must do the relevant ordering from this main depot. For that he uses requisitions to obtain these items on a regular basis.

Figure 5.2 shows a typical requisition form used in a construction firm.

INTERNAL REQUISITION

Company LOGO		Requisition Number
Company Address **ABS Building Construction (Pty) LTD** **PO Box 30 Bergvliet 7864** **Tel: +27 (0) 21 715 6055**		 Contract Number Order Number:
To:	From:	Date:

Please supply or order for the above Site the following which is required by _____ (entre date)

Quantity	Enter full description of materials

Date received	Action by:	Order placed:
		Order Number:
		Delivered:

Figure 5.2 shows a typical requisition

Considerable savings are possible when ordering the basic bulk materials in large loads. Another important consideration here is that transport is not wasted in bringing a few small items, when with a little thought most items can be brought in one good load.

A requisition's contents are very much the same as that of an order. Being an internal document, only the logo may be a bit different.

A requisition could also be used to inform the buying department of some needed goods which the buyer then must order from the suppliers.

Accessories, new tools or unforeseen materials required because of additional work caused by variation orders may be needed to be ordered.

5.3.3 Advice Note

The advice note is sent by the suppler to the site or to the central depot well in advance of the actual delivery. **Figure 5.3** shows a typical advice note used in a construction firm.

ADVICE NOTE		
Company LOGO		
Company Address **ABS Building Construction (Pty) LTD** **PO Box 30 Bergvliet 7864** **Tel: +27 (0) 21 715 6055**		
Invoice to:		To be delivered to:
Delivery date:		Order Number:
Delivery time:		
Delivery vehicle:		
Material	**Quantity**	**Details regarding off-loading and special care**

Figure 5.3 Typical example of an Advice note

The description of the goods, the delivery date and the method of transport and off-loading is stated. If there are any special instructions how to handle and to store the material, it will be mentioned.

This will enable site supervisory staff to make adequate preparation for unloading and storage.

5.3.4 Delivery Notes

The deliver note accompanies the materials when dispatched on site. On it the goods must be described together with the relevant quantities and, above all, the full address of the site must be stated. Valuable time is lost if the driver roams in the area searching for the place.

Figure 5.4 shows a typical example of a delivery note used in a construction firm.

DELIVERY NOTE (Delivery Number :)		
Company LOGO		
Company Address **ABS Building Construction (Pty) LTD** **PO Box 30 Bergvliet 7864** **Tel: +27 (0) 21 715 6055**		
Site	Your Order number:	
Address	Date:	
Please supply the undermentioned goods:		
Quantity	**Description of Goods**	
Remarks	Received By:	
	Delivered By:	
	Date:	
Complaints of shortages or damages cannot be recognized unless notified in writing to the Company's Head Office within 3 days of delivery, stating Note number and Date.		

Figure 5.4 Typical example of a Delivery note

The transport driver will supply two delivery notes: one for himself as a check to his employer that he has made the delivery satisfactorily and one for site

reference. The foreman, site clerk or storekeeper must sign both copies when the truck is off-loaded.

Before that a careful check must be made to ensure that goods comply with the delivery note and that they are according to the description, in good order and not damaged.

In the case that an item is insufficient, it can be returned and must be noted so on this document. The driver should be asked to sign any correction on the delivery note. (An appropriate letter is sent as soon as possible to the supplier.)

When goods arrive in packing cases or crates and it is not possible to examine the contents the foreman should mark the item on the delivery note; *'Not examined'*.

Delivery notes must be collected and sent to the head office of the builder. Here it will be used to compare with the original order and with the invoice before payments are done.

5.3.5 Invoices

Invoices are requests for payment. They look very similar to delivery notes, inasmuch as they state the same basic information. The only difference being that the rates and total prices of the goods are clearly shown.

Because the documents are sent to the builder's head office, the site address is not of such great importance. Instead the firm's postal address is stated.

Before the accounts department does payments, invoices must be checked against the orders from the buying department and the delivery notes from the site. A copy of the invoice should accompany the payment Invoices must be kept for any queries during the final account stage.

Great care must also be taken that invoices are not paid twice. (Some dubious suppliers use the fact that many building firms have not the infrastructure or the knowledge to check on these matters.)

Under no circumstances should drivers of trucks or lorries be paid in account of a delivery note.

Invoices must be awaited before paying anything. This is to ensure that the money reaches its rightful destination but also to be able to control and check the records and bookkeeping.

Figure 5.5 shows a typical example of an invoice used in a construction firm.

INVOICE

(Invoice Number :)

Company LOGO

Company Address

ABS Building Construction (Pty) LTD

PO Box 30 Bergvliet 7864

Tel: +27 (0) 21 715 6055

Account to:	Your Order number:
	Date:
	Our Delivery
Delivered to:	Order Number:
	Date:

Reference	Quantity	Description of Goods	Rate	Amount	
For important conditions see reverse side of this INVOICE			**TOTAL**	**R**	

Figure 5.5 Typical example of an invoice

5.3.6 Receipt

The contractor must insist on receiving receipts. A receipt is a proof issued by the supplier that payment was made. Receipts must be compared with the subsequent invoices to make sure that the invoiced items do not overlap with

those which have been paid already. It is good practice to request regular statements on which the most recent invoiced items and payments are listed.

It is good practice to request regular statements on which the most recent invoiced items and payments are listed.

Receipts are valuable documents and should be kept on file. They may be needed again in cases of disputes, as proof the get paid for 'materials on site.' at interim payments and as basis for calculating 'day-works' for the final account.

Figure 5.6 shows a typical example of a receipt used in a construction firm.

RECEIPT (Receipt Number :)		
Company LOGO		
Company Address **ABS Building Construction (Pty) LTD** **PO Box 30 Bergvliet 7864** **Tel: +27 (0) 21 715 6055**		
Received from:	Date:	
The sum of:	Rands	Cents
Signature:	TOTAL: R	
	With thanks	
In payment of:		

Figure 5.6 Typical example of a receipt

5.4 Combined documents

In recent times, where most of the work is computerized, many of the above mentioned documents may be combined in a way that a number of carbon copies are used. Copies of the delivery notes could be used as invoices and after payment another copy could be used as receipt.

5.5 Cutting down on wastage

Building material is very expensive. The less is wasted the higher could be the profit, the salaries and wages. Also, the less the wastage is, the lower can be the unit prices and the better is the chance to win a tender.

The buying department must make sure that the correct material, the right sizes, strengths and amounts are ordered. Sending back incorrect items increases administration work as well the risk of damage, theft and the supplier not accepting the goods back again. It wastes time, money and energy.

Avoid overstocking, rather order smaller practical quantities. Plenty of material gets wasted while it is piled up on site. In the long run it pays to buy good quality which is a bit more expensive than to buy cheap and low quality material which easily fails the quality control tests.

Supervisors, such as the general foreman, the trades foremen and the Storekeeper, can introduce various methods and ways to stop material being wasted unnecessarily.

When material arrives on site the off-loading and handling must be supervised. Pay attention to careful handling. No damaged material may be accepted from the supplier.

Do the proper standard quality tests when new stocks arrive. Appropriate storing facilities should be ready by this time, so that double handling is avoided and the material can be dispatched immediately at its right place, as near to the construs1ion as possible but out of the way of the traffic. Furthermore, the storage areas must be designed to fit the needs of the different types of material so that they are not damaged in any way before they are built in.

Employ only professional artisans / craftsmen and educate the casual labour to be aware of the wastage problem. Let the workers work with quality tools which are in a proper and good working condition. Choose manual methods above heavy machines; for other cases precise machines may be a better option than unskilled labour.

Artisans / tradesmen must plan well ahead, must do proper preparations, and should measure exactly from drawings before doing any setting out or cutting. (Take the carpenters' motto to heart: "Measure twice, cut once."!) Observe the weather and protect material early enough. Mix small quantities of dagha; do not risk dagha being discarded at the end of the day or being used up in a hurry producing low quality work.

Keep the site tidy so that everything can easily be overlooked md monitored. Collect cutoffs, half bricks etc. and reuse this material for fillings, patchwork and the like.

It is a good idea to do work studies on the larger sites to monitor the wasting habits of the workers and. to improve accordingly. One could make use of sub-contractors and make sure that any damage to material and v1orks is included in their quote. Doing this, the main contractor shifts a big part of the

problem onto somebody else. But this may not necessarily be a wise option as it may again increase the tender price.

5.6 How to prevent theft

Theft costs the construction industry huge amounts of money and ultimately raises the cost to build. At present times in South Africa it is difficult to prevent theft altogether, but at least we can make an effort to keep it low.

Many firms deal with theft by simply increasing the price of their work and by claiming losses front insurance companies. In the long run this ends up in higher tender prices and these firms cannot compete anymore and must close their doors. It is better to try to prevent theft by taking some precautions.

Three types of thieves have to be taken into consideration. First of all there are. The passerby's, persons or staff working on the site and those that make deliveries. The site must be securely fenced with watchmen guarding the gates. Let professional security firms help you. Join the 'business watch' and make use of the police whenever necessary.

5.6.1 Points to consider preventing theft

- There must be enough sheds which can be locked.
- Certain valuable items such as locks, taps and so on are best installed as late during the project as possible. Built in frames are often chained to each other. Avoid overstocking; do not leave material in sight of passerby's. Be aware of temptation.
- Visitors are a problem too. They have to be monitored and no unauthorized people are to be allowed on site.
- Do not allow cars parked near the storage areas or even on the site.
- Advertise that you are aware of theft and that you have a security system in place.
- May be the own employees are the biggest problem. Keep workers occupied at all times.
- If one encourages loyalty, one can trust most of the workers - but-temptation makes thieves. Have thieves caught and punished. It is usually a good deterrent.
- Make sure you know your permanent staff and those casual workers can identify themselves. It is risky to employ cheap labour such as illegal foreigners and people who run from tile law.
- Have a trustworthy storekeeper. Pay him well then be cannot easily be bribed.
- He must keep book of all incoming and handed out materials, tools and other equipment.
- He must see to it that new arrivals on site are packed away immediately. But try to store the goods to be visible to the storekeeper. Mark all tools with the firm's name.

Activity 5.1

1. You are the general foreman of a construction site and you are responsible for the materials which are delivered and stored. How would you see to it that:
   a) Wastage is cut down to a minimum
   b) Theft is prevented
2. Building material has arrived on site. What are the procedures regarding:
   a) Taking delivery
   b) Checking
   c) Handling
   d) Storing
   e) Payment
3. Distinguish between the following documents AND explain their uses in the handling of building materials:
   a) Order form
   b) Advice note
   c) Delivery note
   d) Invoice
   e) Receipt
4. What is the use of the following:
   a) The delivery note
   b) The invoice
   Sketch suitable examples of the above-mentioned TWO documents.
5. Since production depends on the right quantity of components being delivered at the right time, it is essential to organize prompt receipt by follow-up and progressing orders.
   Discuss the following:
   a) Follow-up operations
   b) Progressing orders

Self-Check

I am able to:	Yes	No
o Describe the procurement procedures with reference to:		
o Ordering		
o Follow-up operations		
o Taking delivery and checking		
o Storing		
o Authorizing payment		
o Explain and discuss documentation in the supply of material with reference to:		
o Order forms		
o Requisition forms		

○ Advice notes		
○ Delivery notes		
○ Invoices		
○ Receipts		
• Discuss and explain combined documents		
• Describe cutting down on wastages		
• Explain and discuss how to prevent theft		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 6

Support to Structures

Learning Outcomes
By the end of the module you as a learner should be able to:

- Discuss and explain shoring
- Explain and describe shoring of existing building
- Discuss the purpose and objectives of shoring
- Identify types of shoring
- Describe and explain planking and shuttering
- Explain and discuss excavations
- Discuss the causes of collapse of trenches
- Describe the prevention against risk of collapse of trenches
- Discuss the causes for accidents
- Describe and explain timbering
- By means of sketches explain timbering for:
  - Hard soils
  - Firm soils
  - Dry soils
  - Loose wet soils

6.1 Introduction

Support to structures is very important on a building project. In this module you will understand and gain the knowledge of temporary supports to structure on a building project.

6.2 Shoring

Shoring is the construction of a temporary structure to support temporarily an unsafe structure. These support walls laterally. They can be used under the following circumstances:

1. When walls bulge out
2. When walls crack due to unequal settlement of foundation and repairs are to be carried out to the cracked wall.
3. When an adjacent structure needs pulling down.
4. When openings are to be newly made or enlarged in a wall.

Shoring is a general term used in construction to describe the process of supporting a structure in order to prevent collapse so that construction can proceed. The phrase can also be used as a noun to refer to the Buildings- It is used to support the beams and floors in a building while a column or wall is removed. In this situation vertical supports are used as a temporary replacement for the building columns or walls.

Trenches - During excavation, shoring systems provide safety for workers in a trench and speed excavation. In this case, shoring should not be confused with shielding. Shoring is designed to prevent collapse where shielding is only designed to protect workers when collapses occur. Concrete structures shoring, in this case also referred to as falsework, provides temporary support until the concrete becomes hard and achieves the desired strength to support loads.

6.2.1 Shoring of existing building

- Shoring is the temporary structure used to support the unsafe structure temporarily.
- It may be used in all cases of strengthening any parts of the building and to give lateral support to the wall at risk.
- Necessity of Shoring.
- When a wall cracks due to unequal settlement of foundation.
- When adjacent structure is to be dismantled.
- When a wall shows sign of bulging out.
- When openings are to be made or enlarged in a wall.

6.2.2 Purpose and objectives of shoring

- To give lateral support to walls, which are at risk (bulging or leaning outwards).
- To avoid failure of boundary wall caused by removal of adjacent support.
- To give support to adjacent building during demolition works.
- To support upper part of wall during formation of larger opening.
- To give support to a floor or roof to enable a support wall to be removed and replaced by a beam.

6.3 Types of shoring

1. Raking shoring (slant or sloped shore)
2. Dead shoring (vertical shore)
3. Flying shoring (horizontal shore)

6.3.1 Raking shore (slant or sloped shore)

In this method, inclined members known as rakers are used to give lateral supports to walls. This is inclined support to the unsafe wall.

The following points are to be kept in view for the use of the raking shores:

1. Rakers are to be inclined in the ground at 45°. However the angle may be between 45° and 75°.
2. For tall buildings, the length of the raker can be reduced by introducing rider raker.
3. Rakers should be properly braced at intervals.
4. The size of the rakers is to be decided on the basis of anticipated thrust from the wall.
5. The centre line of a raker and the wall should meet at floor level.
6. Shoring may be spaced at 3 to 4,5m spacing to cover longer length of the bar.
7. The sole plate should be properly embedded into the ground on an inclination and should be of proper section and size.
8. Wedges should not be used on sole plates since they are likely to give way under vibrations that are likely to occur.

A raking shore consists of the following components:

1. Rakers or inclined member
2. Wall plate
3. Needles
4. Cleats
5. Bracing
6. Sole plate

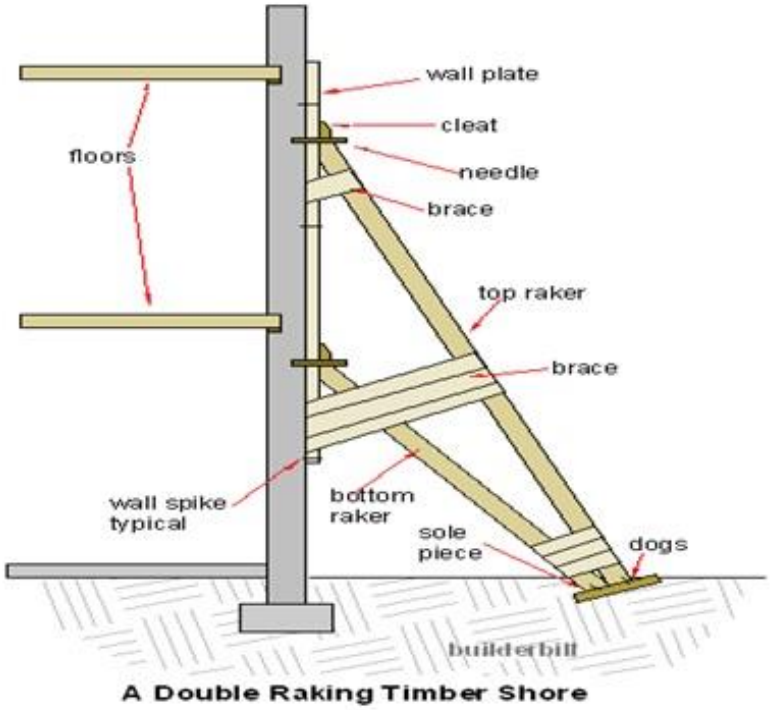


Figure 6.1 Double Raking Timber Shore

Constructional requirements:

- Rakers inclined to ground 45° but not steeper than 75° degree.
- Shoring spacing 3 to 4.5m, rakers properly braced, sole plate properly embedded into ground and should not be wedged.

Procedure:

1. Site investigation and marking out the location.
2. Fixing of wall plate with needle and cleats inserted to the holes in the external wall.
3. Setting a firm ground level.
4. Cutting the rakers to appropriate length and fixed to cleats on the wall plate.
5. Rakers are braced and tightened with the help of wedges.
6. Near the sole plate, rakers are tied together with hoop iron.

6.3.2 Flying shoring (horizontal shores)

It is a system of providing temporary supports to the party walls of the two buildings where the intermediate building is to be pulled down and rebuilt. All types of arrangements of supporting the unsafe structure in which the shores do not reach the ground come under this category.

They flying shore consists of wall plates, needles, cleats, horizontal struts (commonly known as horizontal shores) and inclined struts arranged in different forms which varies with the situation. In this system also the wall plates are placed against the wall and secured to it.

A horizontal strut is placed between the wall plates and is supported by a system of needle and cleats. The inclined struts are supported by the needle at their top and by straining pieces at their feet. The straining piece is also known as straining sill and is spiked to the horizontal shore. The width of straining piece is the same as that of the strut.

When the distance between the walls (to be strutted apart) is considerable, a horizontal shore cannot be safe and a trussed framework of members is necessary to perform the function of flying shore.

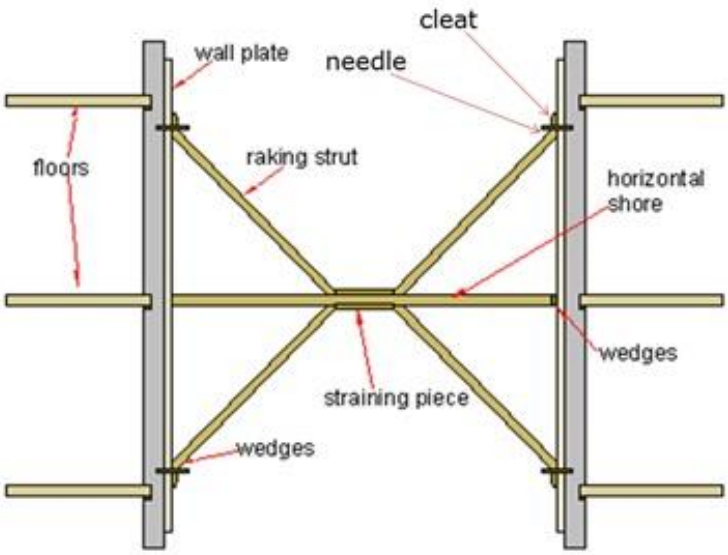


Figure 6.2 Single Flying Timber Shore

Such shores are used to give horizontal support to two adjacent parallel party walls which have become unsafe due to removal or collapse of the intermediate building.

Constructional requirements:
- If 2 walls up to 9m span- use single flying shore

Otherwise double flying shore
- Centerline of struts, flying shore and those of walls meet at floor level of two buildings.
- Strut preferably inclined at 45° and <60°
- Spacing of flying shore 3 to 4m along walls with horizontal bracing between adjacent shores.
- Large factor of safety due to unknown actual loads.

Procedure: refer raking shore

6.3.3 Dead shoring (vertical shoring)

This type of shoring used to support dead load which acts vertically downwards. It consists of arrangement of dead shores (posts) and needle beam to support the load.

Used to rebuild the defective lower portion of wall, deepen the existing foundation and to make large opening on existing wall at lower portion.

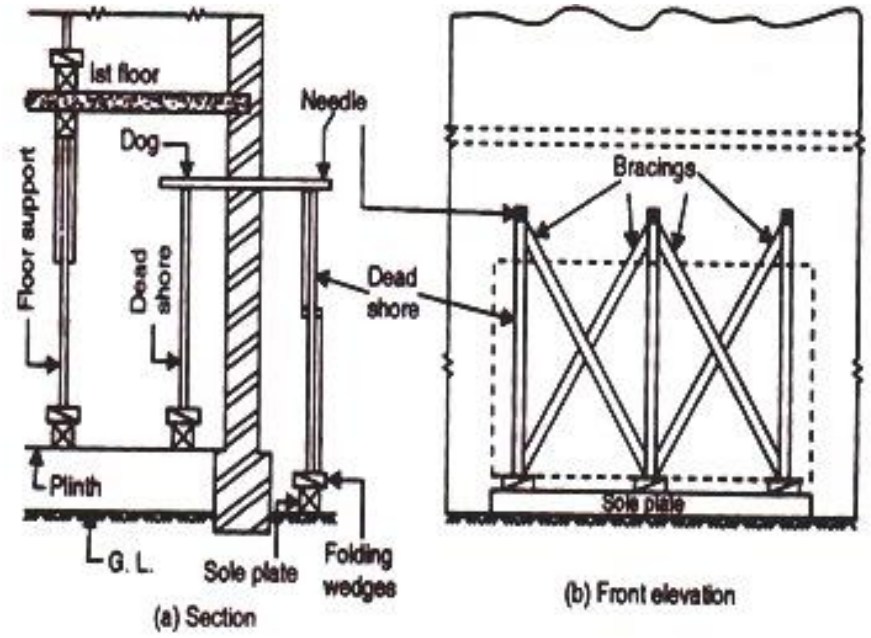


Figure 6.3 Dead shoring

Constructional requirement

- Adequate section of needle and dead shores to transfer load.
- Needles are spaced at 1to 2m, minimum 3 needles for an opening.
- Length of outer dead shores> length of inner dead shores for external wall.
- Dead shores are supported on sole plate.
-

Dead shore procedure

1. Investigate site and marking out location.
2. Holes are made in appropriate position in the external wall.
3. Needle beam is inserted through the hole in the wall.
4. Needle beam is supported with vertical posts at the end of offsetting from the wall.
5. Dead shore (vertical post) are fixed on the firm ground surface above the sole plate and tightened with the help of folding wedge.
6. Before dismantling defected area of wall, all doors, windows, floors, wall above are properly strutted.
7. Should be kept in position till new unit is constructed.

6.4 Planking and shuttering

Planking and strutting is the term used to give temporary support to the sides of excavations and it is sometimes called timbering. The sides of some excavations will need support to protect the operatives while working in the excavations and to keep the excavation open by retaining the sides of the trenches.

6.5 Excavations

Before a foundation can be laid it is necessary to excavate a trench of the required depth and width. On small contracts this is still carried out by hand but on large works it may be economic to use some form of mechanical trench digger. The general procedure for the excavation of foundation trenches is illustrated in **Figure 6.4.**

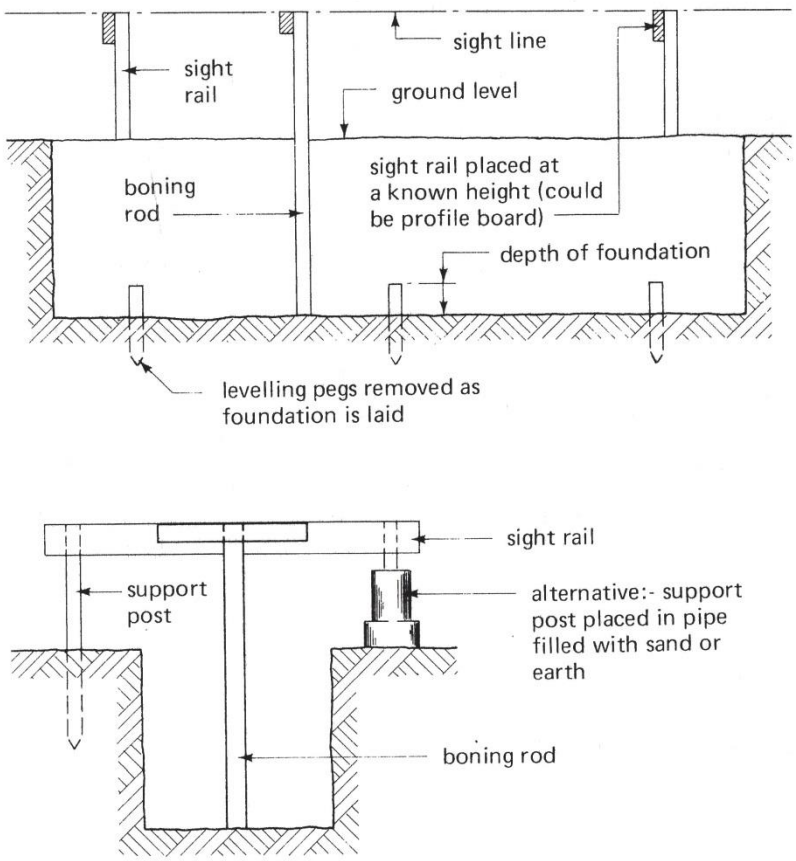


Figure 6.4 Trench excavation

6.5.1 Causes of collapse of trenches

- When excavations are very deep, the steep sides cannot carry their own weight.
- The nature of the soil may not be very favourable for excavations. Sand pockets, gravel and roots of plants are some examples. Excavating in soil where there was excavated and filled before is always a problem, because the soil is never as good compacted as found originally.
- Nearby plant and vehicles on busy roads cause vibration.
- The weight of the, excavated material placed too near on the edge of trenches causes the sides to crumble. People walking near the edge and equipment and building material placed there are also a problem.
- Weather conditions could be another problem. Heavy rains erode sides of trenches.
- Trenches left open for a long time will collapse eventually.
- Workers in the trenches could damage the sides by being careless with their tools.

- Even the method of excavation could be problematic. A backactor cannot be as cautious and precise as human hands. It easily bumps the edges of the trench.

6.5.2 Preventions against Risk of Collapse

- Fence in the site.
- Excavate in practical stages, leaving the excavations not open for too long. Continue with the foundation concrete and brickwork as soon as possible. Prevent delays.
- Have sloping sides to the excavations. If the space is available, this could be. Practical for basement excavations as it allows for working space at the same time. Though for trench excavation this is very expensive, because it causes that the concrete must have (more) shuttering and more backfilling to the sides is required.
- Get rid of ground water and rainwater immediately by pumping and bailing.
- Excavate by hand, do not use machines, especially for the final touches.
- Horizontal side piles may be used.
- Use planking and strutting.

6.5.3 Causes for accidents

Too many trench accidents happen because the work has not been properly planned or executed. Before digging is started, the following should be checked.

- Excavated earth on the edge of the trench collapsing together with the side of the trench
- Poor soil conditions
- Nearness of buildings, utilities, heavily trafficked high ways, and any other source of vibration
- Ground that has been previously disturbed
- Closeness of streams, old sewers, underground cables etc.
- Insufficient equipment, personal protective gear, shoring materials, signs, warning lights etc.

6.5.4 Prevention of trench accidents

While digging is underway, the following should be cared of:

- Excavated material must be more that 600 mm away from the edges of the trench
- Positioning of heavy equipment and material (sewer pipes).
- The changing ground conditions, particularly after rainfalls
- The way in and the way out of the excavations
- That no low oxygen or gaseous conditions appear in the trench
- For changes in vehicle traffic patterns, keep trucks away from trench walls
- Proper positioning of cross bracing or jacks to prevent shoring from moving

- That people know safe and proper procedures and that they do not endanger themselves by ignoring these checks

6.6 Timbering

In open timbering there are gaps between the timbers which support the trench sides hence the method is suitable only for hard or firm soils.
In closed timbering there are no gaps between the timbers supporting the ground, hence this method is used in soft and wet soils. Typical details of timbering to trenches are shown in **Figures 6.5** to **Figure 6.8**

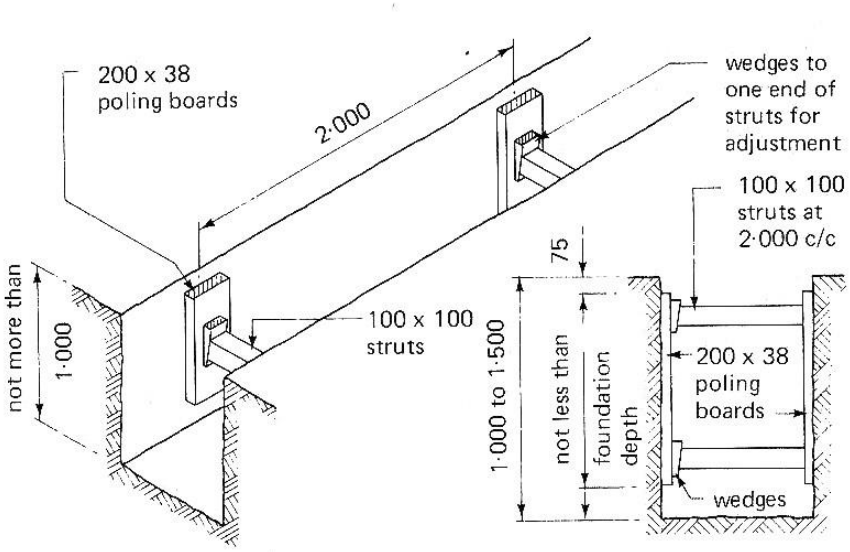


Figure 6.5 Typical timbering in hard soils

Timbering
This is a term used to cover temporary supports to the sides of excavations and is sometimes called planking and strutting.

The sides of some excavations will need support to:

1. Protect the operatives while working in the excavation.
2. Keep the excavation open by acting as a retaining wall to the sides of the trench.

The type and amount of timbering required will depend upon the depth and nature of the subsoil. Over a short period many soils may not require any timbering but weather conditions, depth, type of soil and duration of the operations must all be taken into account and each excavation must be assessed separately.

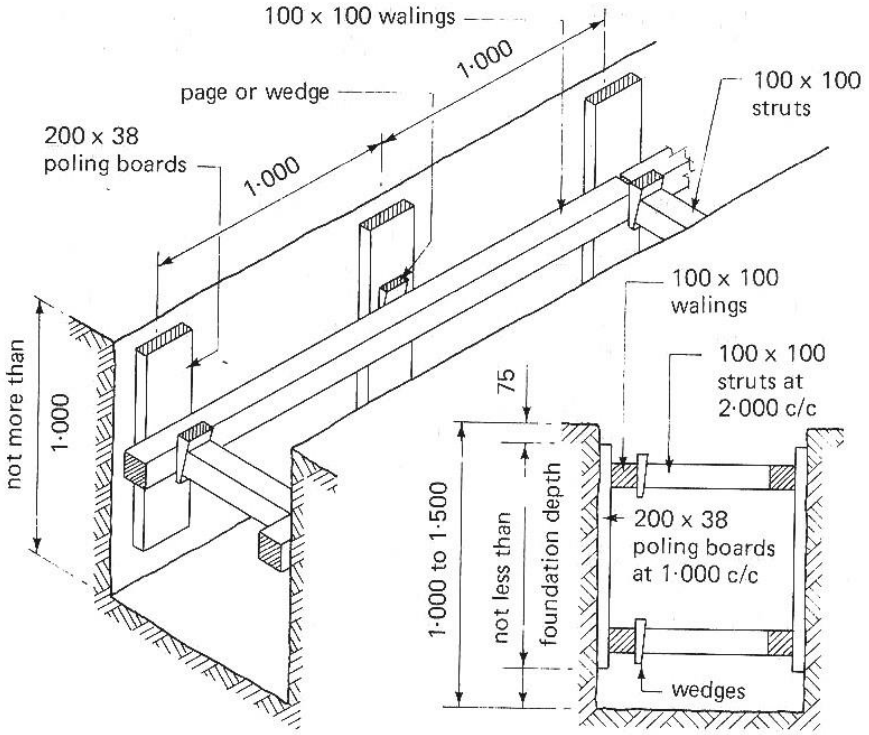


Figure 6.6 Typical timbering in firm soils

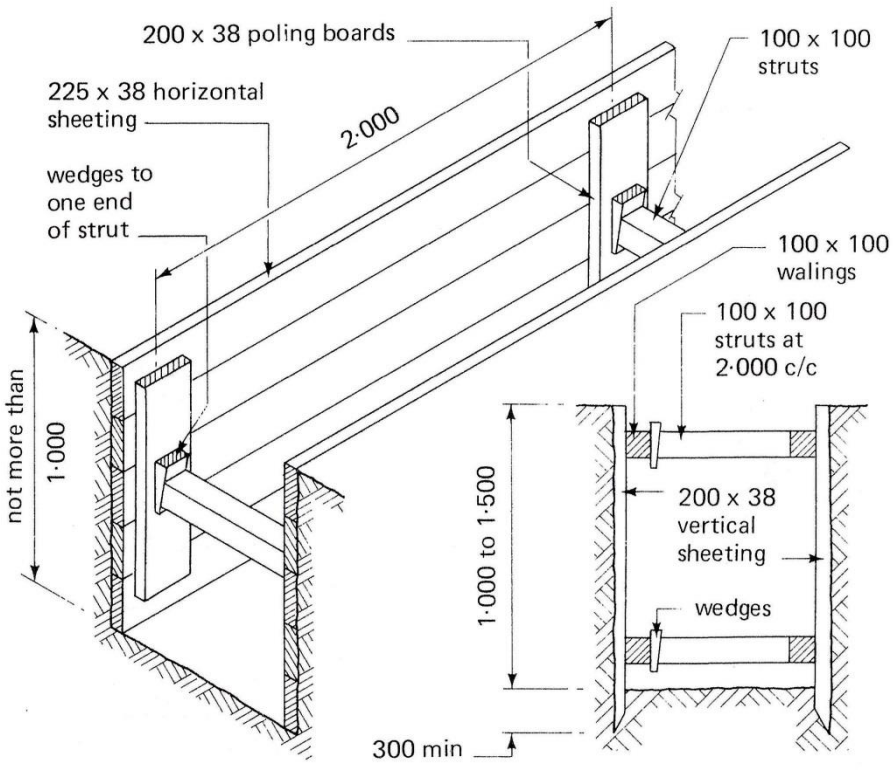


Figure 6.7 Typical timbering in dry soils

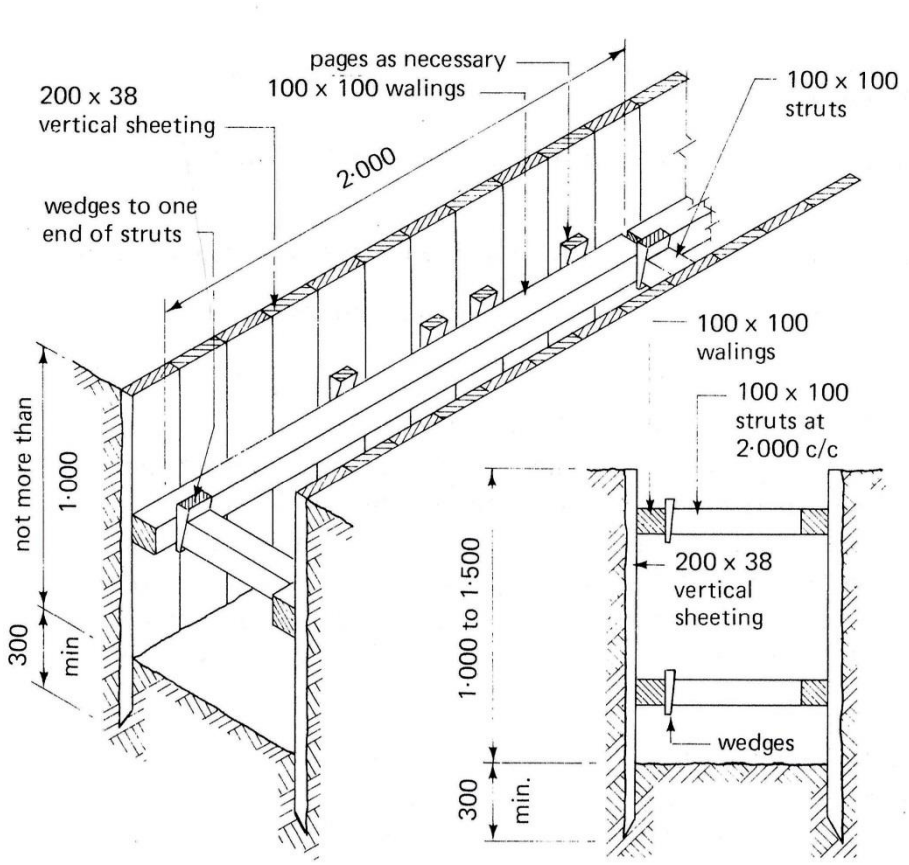


Figure 6.8 Typical timbering in loose wet soils

In open timbering, the planks that are vertically placed against the face of the sides of the trenches, are the poling boards. They transfer the load from the ground into the struts.

The struts are the horizontal members at a right angle between the poling boards. They are positioned across the trench.

To tighten the system triangular shaped wedges are driven in between the connections.

When loads are needed to be distributed more evenly, waling could be placed across the poling boards parallel to the trench before the struts are placed in position.

In loose (river sand) and dry (dune sand) the vertical sheeting of the closed timbering is driven into the sand before the excavation work starts. Digging takes place in stages; after a certain depth, the sheets are driven in deeper. For this) the planks must be cut at an angle to give it a sharp edge at the bottom.

In loose, wet soils (swampy ground) horizontal sheeting replaces the vertical sheeting. Again excavation is done in stages, putting the planking and strutting in place as the digging proceeds.

TAKE NOTE:
Finally, it is interesting to note that as Shoring, Planking and Strutting are only temporary structures; they are not measured in detail in the bills of quantities. Tile employer only pays for them if the tender inserted a unit price for the whole item under Preliminaries in the bills.
Though, because Underpinning is permanent, all labour and material items will be found under the relevant Trades in the bills of quantities.

Activity 6.1

1. Consider timbering in trench excavations. Explain the following terms:
   a) Planking and strutting
   b) Poling board
   c) Waling
   d) Struts
   e) Wedges

2. Make use of clear, labeled sketches to show how the following supports weak structures:
   a) Flying shores
   b) Raking shores

3. Make isometric labeled sketches to clearly show the construction of the planking and strutting in trench excavations approximately one metre deep , in the following formation:
   a) Soft ground (loose wet)
   b) Loose ground (loose dry)

4. When timbering is not applied to the sides of trenches, the excavation could collapse.
   a) State SIX (6) general causes why trenches could collapse
   b) Briefly explain FOUR (4) safety precautions (other than timbering) to prevent the collapse of trench excavations.

5. Shoring is the provision of temporary support to a structure in order to save the structure and to prevent danger in the meantime to people from possible collapse. Clearly define, explain or sketch the following to show its use in connection with dead shores ANDI/OR raking shores:
   a) Wail plate
   b) Needles and cleats

c) Folding wedges
d) Sole plate
e) Dog

6. The load on an existing building is to be increased and therefore the building has to be underpinned. Explain the method of underpinning by means of enlarged footings. INCLUDE a sketch of the sequence plan.

Self-Check

I am able to:	**Yes**	**No**
• Discuss and explain shoring		
• Explain and describe shoring of existing building		
• Discuss the purpose and objective of shoring		
• Identify types of shoring		
• Describe and explain planking and shuttering		
• Explain and discuss excavations		
• Discuss the causes of collapse of trenches		
• Describe the prevention against risk of collapse of trenches		
• Discuss the causes for accidents		
• Describe and explain timbering		
• By means of sketches explain timbering for:		
o Hard soils		
o Firm soils		
o Dry soils		
o Loose wet soils		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 7

Scaffolding

Learning Outcomes
On completion of this module you as a learner should be able to:

- Discuss and explain the erection of simple metal scaffolds and trestles
- Apply the relative safety precautions to be observed under the Factories, Machinery and Building Works Act

7.1 Introduction

In this module you will learn about the erection, inspection and dismantling of scaffolding. Scaffolding is a temporary structure used to support people and material in the construction or repair of buildings and other large structures.

7.2 Metal scaffolding

7.2.1 Components

Basic 50 mm tubes and patent fittings are the components of metal scaffolding.

Up to a few years ago wood was extensively used in making components for scaffolding. E.g. wooden poles for multi-story buildings, wooden trestles for low work etc.

Like all other things, scaffolding has also changed owing to the pressure of work. This meant that the old wooden scaffolding was too cumbersome and too much time was wasted in the erection.

Today, most contractors make use of tubular scaffolding, because of the ease with which it can be erected and stored. We will discuss metal scaffolding under the following headings:

- Trestles
- Tubular scaffolding
- Patent scaffolding

7.3 Trestles

Trestles can be discussed under the following sub-headings:

- Putlog trestles
- Double folding trestle
- Unitrestle

7.3.1 Putlog trestle

The putlog trestle looks like the commonly used double folding or telescopic trestle, but with the difference that it has only one pair of legs instead of the standard two pairs.

It is ideal for bricklayers, and can be folded for easy storage. The putlog trestle is illustrated below in **Figure 7.1.**

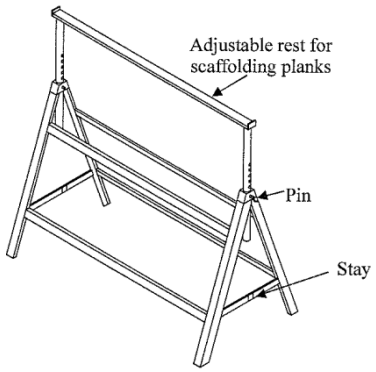


Figure 7.1 The putlog trestle

7.3.2 Double folding trestle

The double folding trestle (see **Figure 7.2**) is the most commonly used piece of scaffold equipment. It is ideal for plasterers, painters, bricklayer and many other trades.

Figure 7.2 The double folding trestle

The trestle is sometimes referred to as the telescopic trestle because it has a transome which is adjustable allowing the top section to pull out to a maximum height of 2,500 mm.

The trestles are manufactured in three sizes:

- 1 067 mm which extends to 1 829 mm
- 1 219 mm which extends to 2 032 mm
- 1 372 mm which extends to 2 438 mm

7.3.3 Unitrestle

The unitrestle (see **Figure 7.3**), as the name implies, consist of two legs joined together to make a single frame. It is ideal for plasterers and interior decorators.

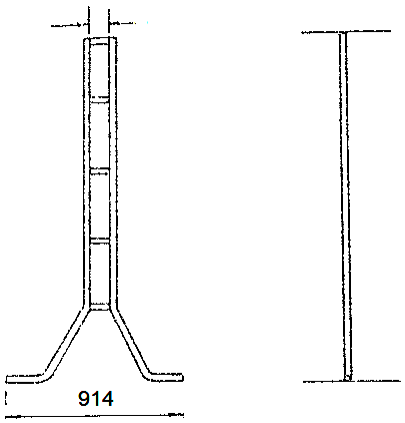


Figure 7.3 The unitrestle

Because it has no moving parts it requires very little maintenance and can easily be stored. The unitrestle is used together with an ordinary scaffold board (see **Figure 7.4**) on edge between the frames.

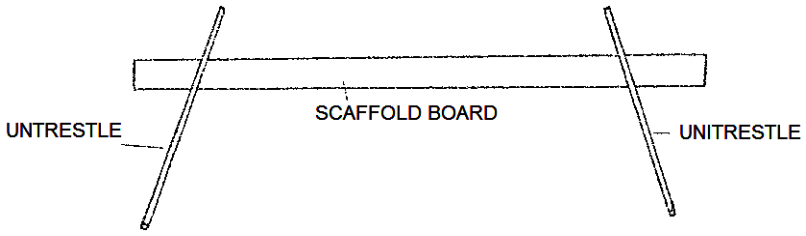


Figure 7.4 Scaffold board

7.4 Tubular scaffolding

Tubular scaffolding is used extensively throughout South Africa today because of its easy erectability, strength and easy storage. This type of scaffolding is erected by unskilled labourers under supervision of a trained operator.

The tubular scaffolding can be classified under two headings:

- Putlog scaffold
- Independent scaffold

7.4.1 Putlog scaffold

Illustrated below in **Figure 7.5** is an example of a putlog scaffold showing the different components of which the scaffold is made up. This is sometimes called a single scaffold as against the independent or double scaffold.

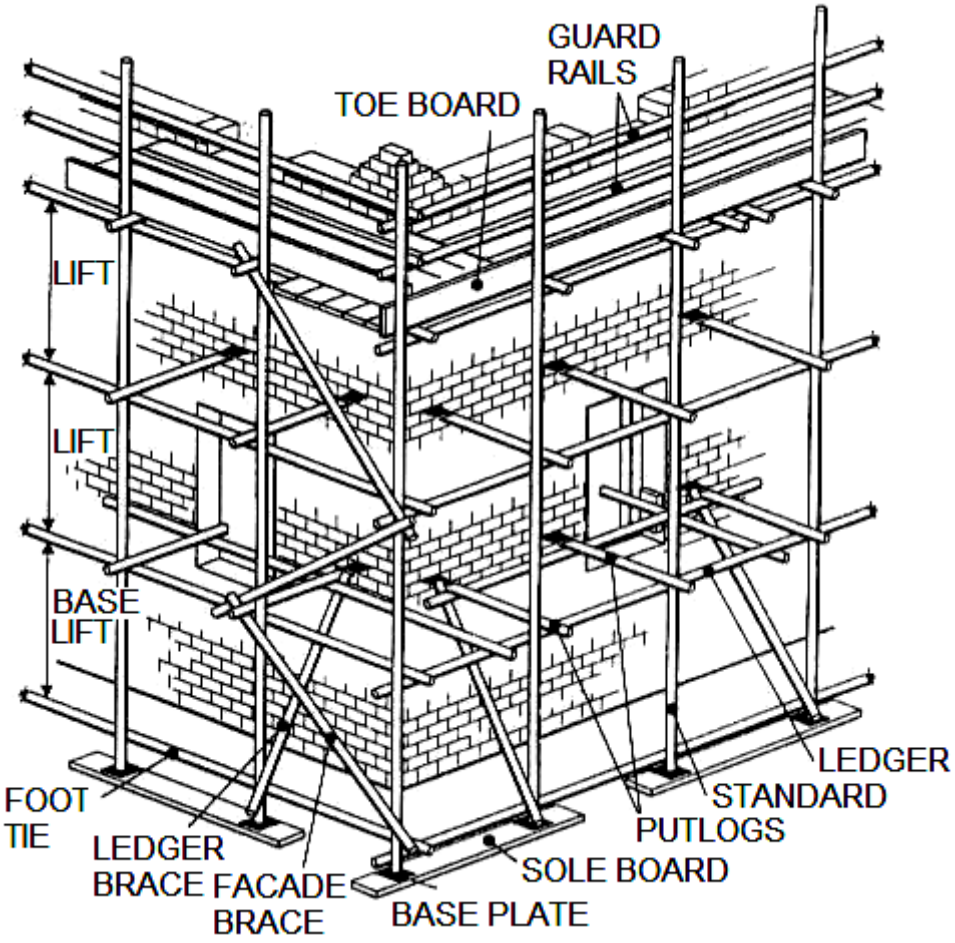


Figure 7.5 a Putlog scaffold showing different components

In this construction, one end of the putlog is fixed between the courses of brickwork, the other end to the standard by ninety-degree clip or else to the ledger by put log clip.

Usually the ledgers are spaced at 1 371 mm centres approximately, to lessen fatigue experienced by bricklayers in reaching above this height. A minimum amount of bracing is required, as use is made of the wall itself.

The scaffold can be rapidly erected as the work progresses if provision is made for the putlogs while the brickwork is green.

7.4.2 Independent scaffold

This is sometimes called the double scaffold (see **Figure 7.6**), since it incorporates two rows of uprights or standards and is not dependent on the building itself in any way as a factor in the carrying of loads.

For normal work, the standards are placed in pairs 1 041 mm apart to provide a platform the width of 228 mm scaffold planks between standards, the lifts being approximately 1 828 mm to give reasonable head room and mobility on the scaffold.

Bracing is required to make the scaffold rigid, and ties into the face of the building for stability.

This type of scaffold can be erected ahead of building work if necessary, and ties can be made to the frame of the building whether this consists of steelwork or reinforced concrete.

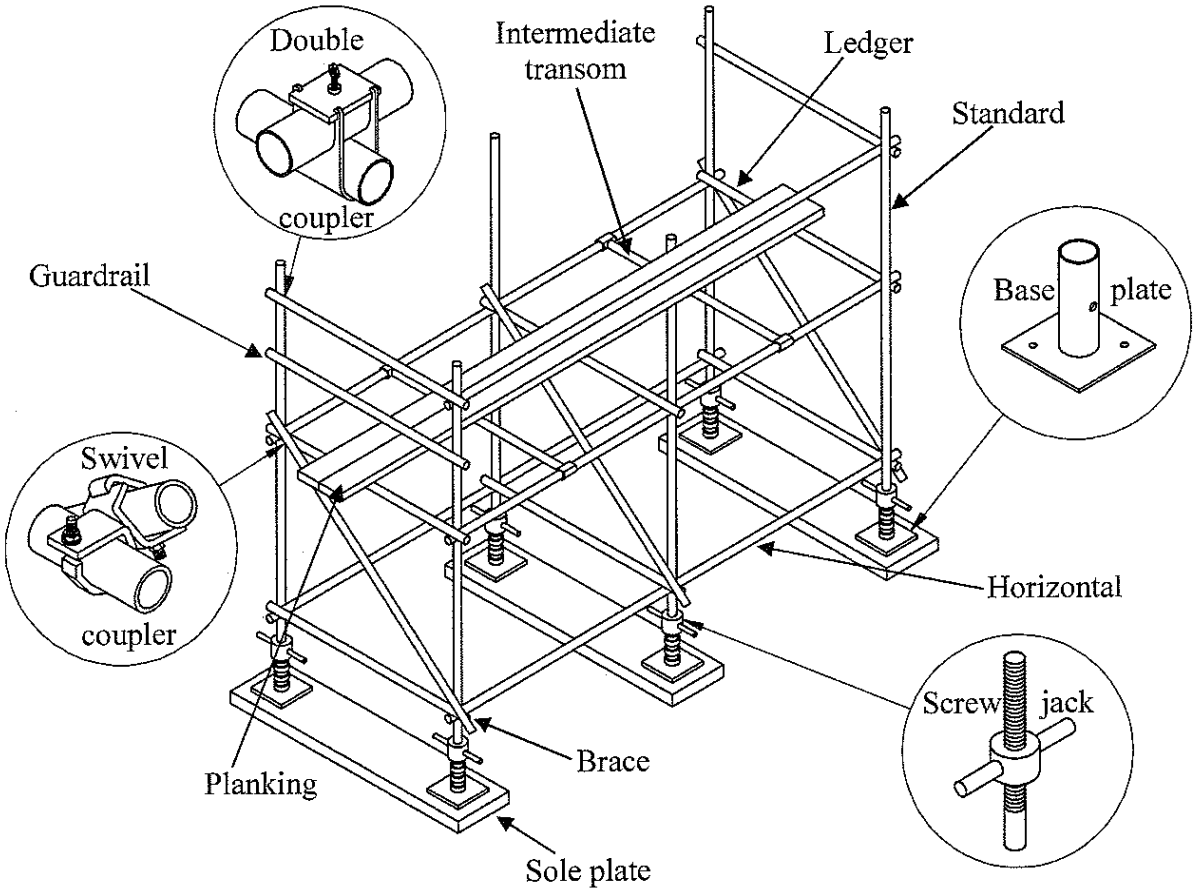


Figure 7.6 The double scaffold detailing different components

In **Figure 7.7 (a)-(b)** tubular scaffolding is used in the construction of a tower reservoir.

Figure 7.7(a) Tubular scaffolding

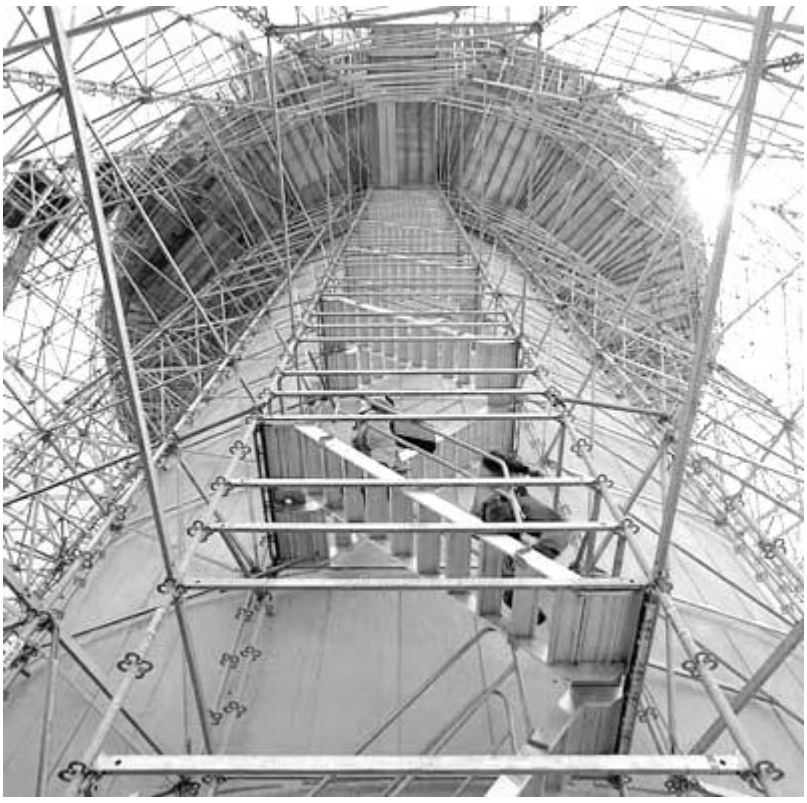


Figure 7.7(b) Tubular scaffolding

In **Figure 7.8** another example in the use of tubular scaffolding is shown.

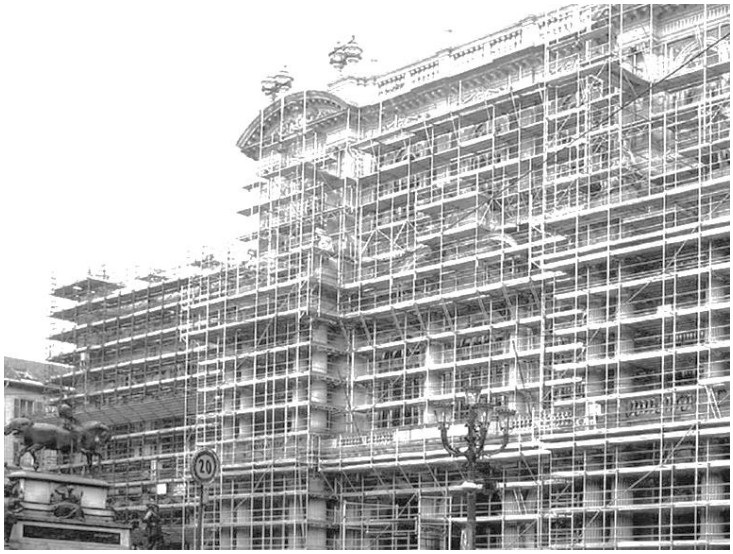


Figure 7.8 Tubular scaffolding

Different types of couplers used in tubular scaffolds (see **Figure 7.9** to **Figure 7.12**).

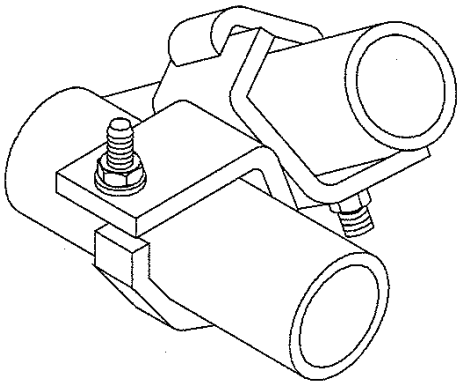


Figure 7.9 Swivel coupler

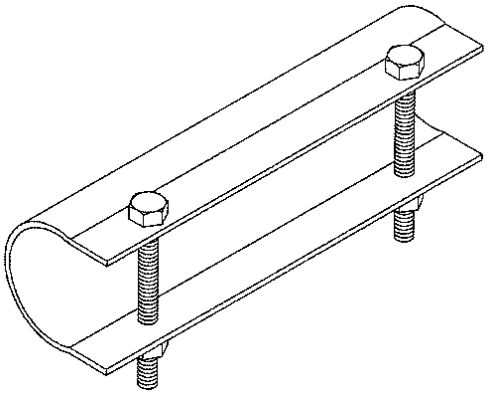


Figure 7.10 Sleeve coupler

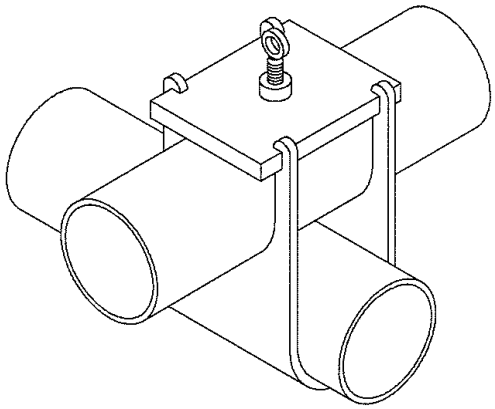


Figure 7.11 Double coupler

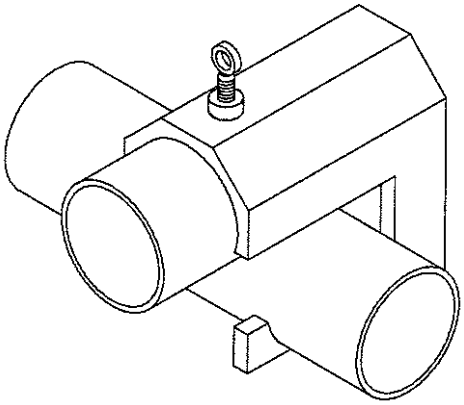


Figure 7.12 Putlog coupler

7.5 Patent scaffolding

Besides the different types of trestles and tubular scaffolding equipment we also find patent scaffolding in use today. We will briefly discuss three types obtainable from G.K.N. Mills.

- Hy-lite
- Speed frame
- Self-lock.

7.5.1 Hy-lite

Hy-lite is a new and improved form of the well-known and well tried "H-FRAME". Basically it is a frame available in various heights for use as scaffolding or support work.

It is of standard four board width and will accommodate toe-boards and guard rails. Hy-lite can be erected by an unskilled labourer in a very short time.

To erect this type of scaffolding, a person needs no tools such as spanners etc. The frames are manufactured in 5 different heights; 914, 1219, 1524, 1829, 2134 cm. The width remains the same in all the frames.

A large number of fittings are obtainable to erect a scaffold with Hy-lite frames.

- **Assembly**

Erect in towers fitting cross bracing as you go. After assembling the first frames fit the type of feet you require.

7.5.2 Speed frame

The basis of the "Speed frame" system is the range of frames illustrated below in **Figure 7.13**. These are all 1 500 mm wide and from 660 mm to 2 289 mm in height and are easily stacked for transportation and storage.

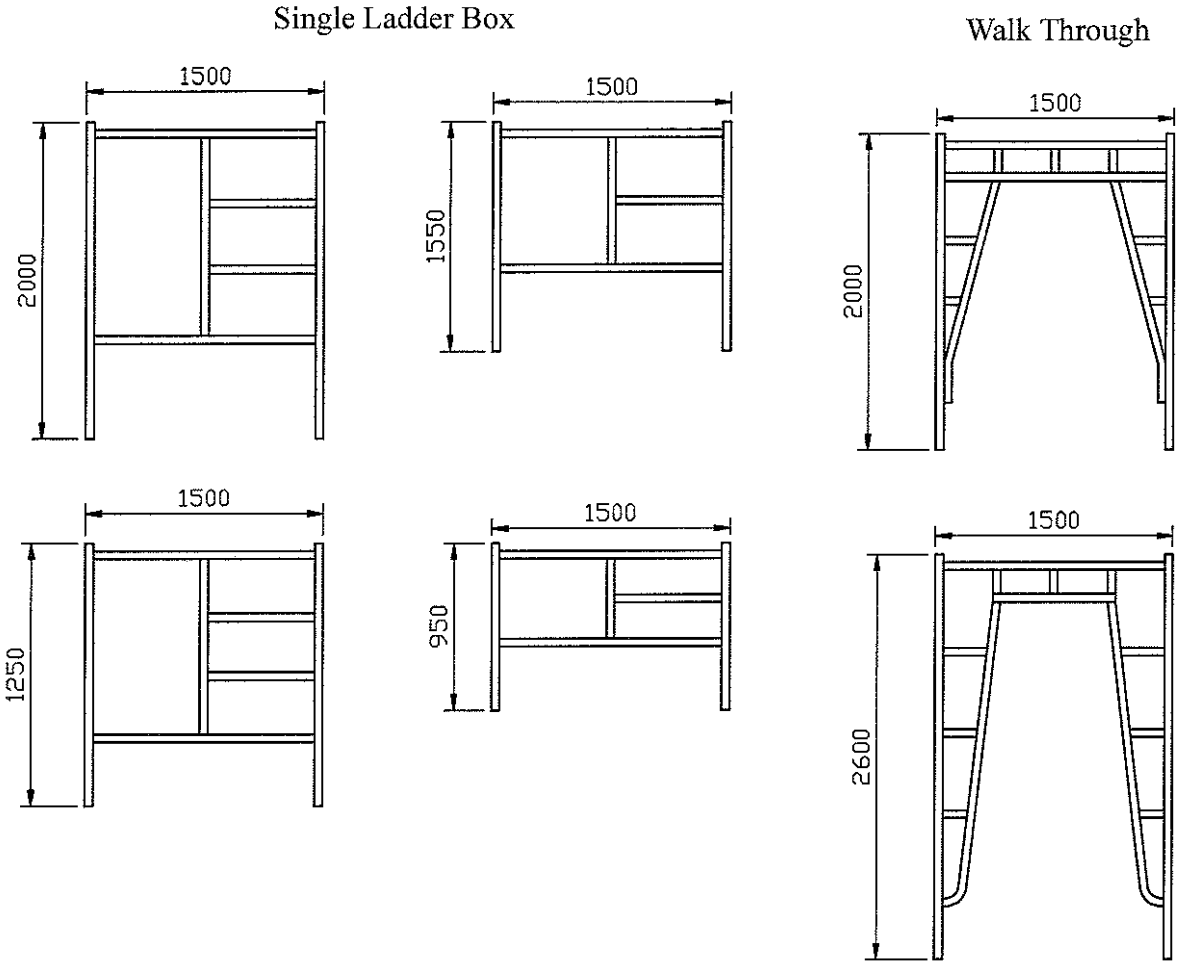


Figure 7.13 Speed frames

Manufactured from light tensile steel tubes electrically welded, each frame contains its own built in ladder unit making climbing easy on any scaffold system.

Ladder rings can also be used to support 914 mm wide material platform whilst a 457 mm walk-through platform is available on every frame.

Besides the frames illustrated in **Figure 7.13**, there is also "bridge frames" and ladder frames.

Ladder frames are available in three alternate heights, and are most useful for forming small structures, either rolling or fixed, for painting or maintenance work.

The "flip locks" on the ladder frames enable cross bracing to be effected, and castors or loose plates may be inserted into the legs as required. Scaffold planks may be set at any range level to suit the working height.

Bridge frames are used where obstructions are excessively wide, the light or heavy duty bridge frames are used in pairs to join adjacent towers.

This reduces the amount of scaffold needed and provides large platforms economically.

Illustrated below in **Figure 7.14** are two examples of "speed-frame" frames used for scaffold.

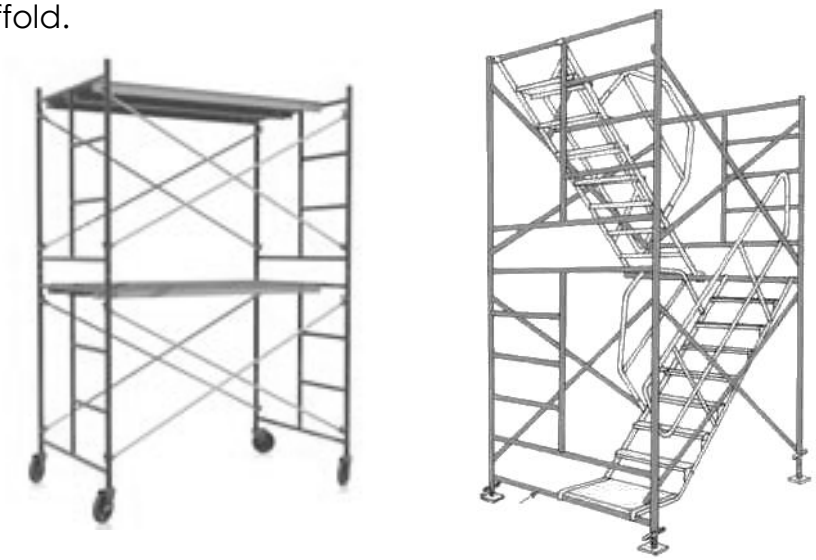


Figure 7.14

The left tower scaffold is on castors - the other on base plates. In this type of patent scaffolding there is also a number of fittings available to suit different types of jobs.

7.5.3 Self-lock

Patent self-lock scaffolding is the simplest and fastest system ever devised.

The rigidly welded self-aligning frames and components simply slot together, without the use of tools or fastenings of any kind, to form access towers, platforms and runs of scaffolding that can be erected in minutes by unskilled labour.

It is also far quicker to dismantle than any other form of scaffolding. It stacks compactly for transporting, and storage and can be used and re-used in hundreds of different types of jobs.

The illustration below (see **Figure 7.15**) shows a completed tower scaffold erected with self-lock frames.

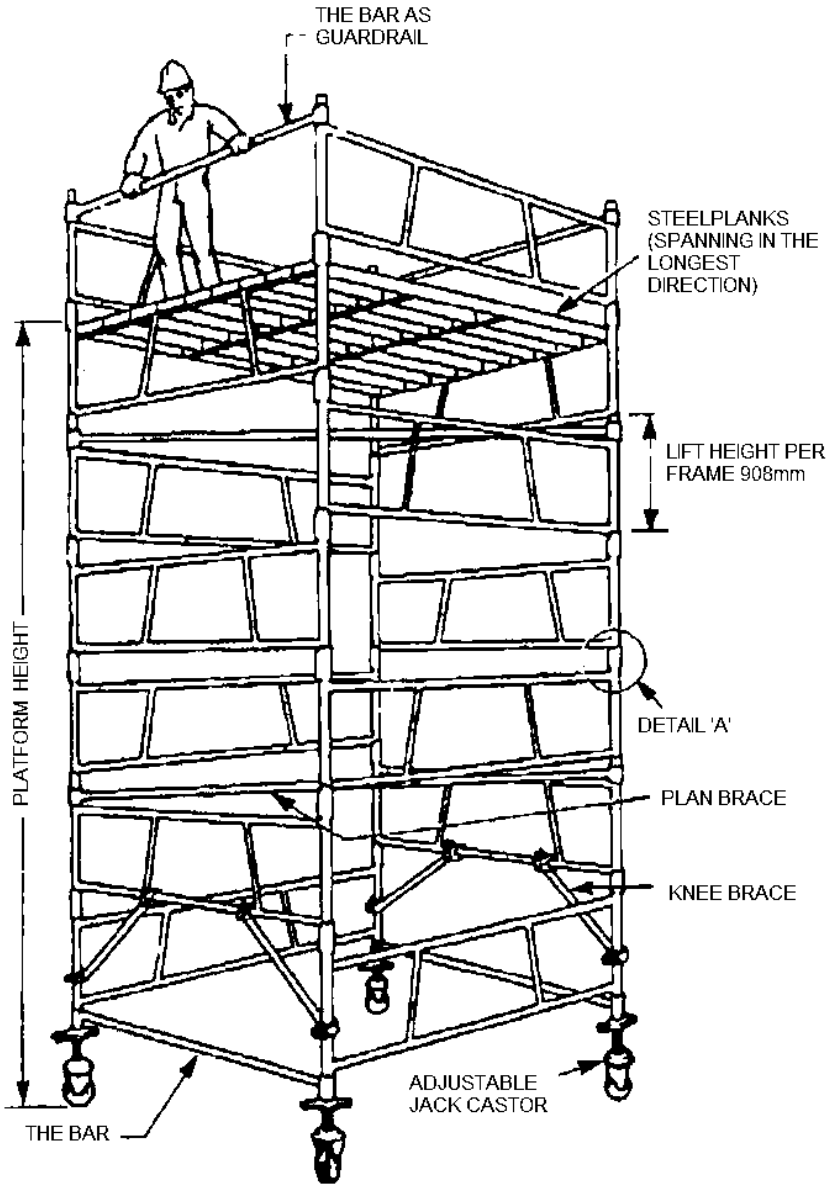


Figure 7.15 A completed tower scaffold erected with self-lock frames

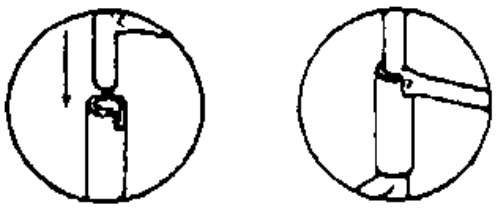


Figure 7.15 A completed tower scaffold erected with self-lock frames (continued)

As in the case of ordinary tubular scaffolding, a variety of fittings are obtainable.

Activity 7.1

1. Why is there a bigger demand for metal than for wooden scaffolds?
2. Name the different members of a putlog scaffold.
3. Describe the difference between a putlog scaffold and an independent scaffold.
4. Describe the term "Hy-lite" briefly and make a neat line sketch illustrating a Hy-lite frame.

Self-Check

I am able to:	Yes	No
• Erect simple metal scaffolds and trestles		
• Apply the relative safety precautions to be observed under the Factories, Machinery and Building Works Act		

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

Module 8

Lifts and Cranes

Learning Outcomes
On completion of this module you as a learner should be able to:

- Describe, explain and make freehand sketches of different types of cranes and hoists
- Discuss and explain the parts of cranes
- Describe and explain the erection of cranes

8.1 Introduction

Cranes and lifts are important pieces of equipment on most major building and construction sites in South Africa. For centuries hoisting apparatus has been in use to raise, lower and transport heavy loads over short distances.

Today, there are travelling cranes in steel mills and power plants, as well as hammerhead cranes in naval shipyards, all capable of lifting hundreds of tons.

A **crane** may be defined as a device or machine for lifting loads by means of a rope. A **crane** is a multi-purpose machine. Its main use is to move or displace heavy loads and loads that are difficult to handle because of their size.

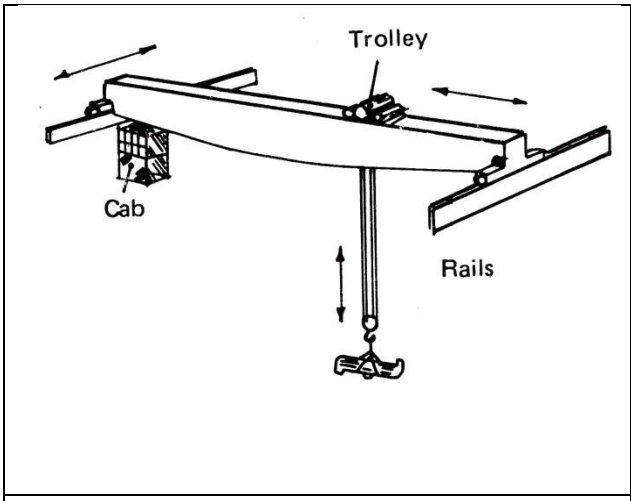
8.2 Types of Cranes and Hoists

Builders' cranes can be defined as power-operated lifting tackles with jibs (or booms) which can move loads a considerable distance horizontally as well as lift and lower them by means of a hook on a rope.

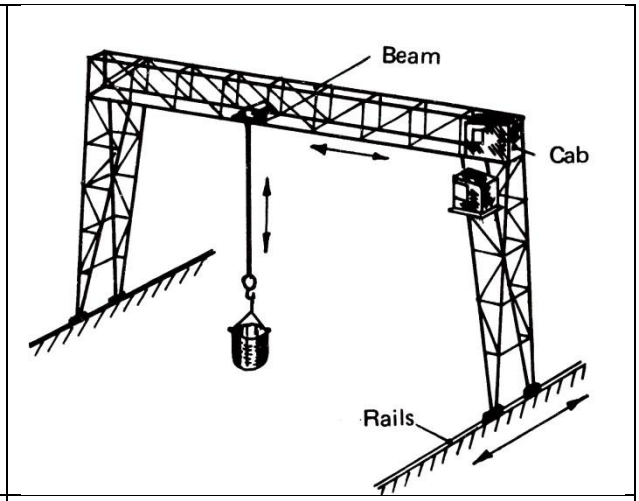
The use of cranes has greatly increased in the construction industry due mainly to the need to raise the large and heavy prefabricated components often used in modern structures.

The range of cranes available is very wide and therefore actual choice must be made on a basis of sound reasoning, overall economics, capabilities of cranes under consideration, prevailing site conditions and the anticipated utilisation of the equipment.

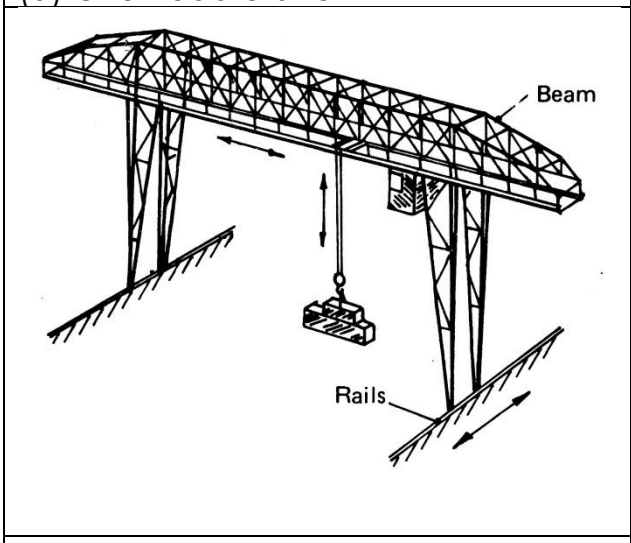
Cranes consist of a variety of designs, some of which are shown in **Figure 8.1**



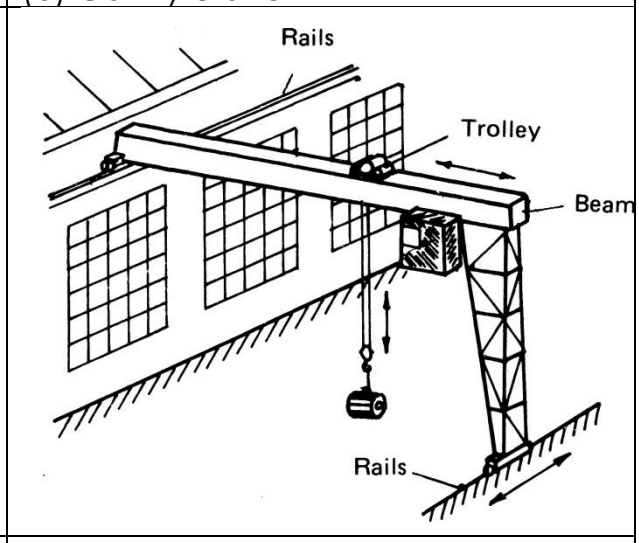
(a) Overhead crane



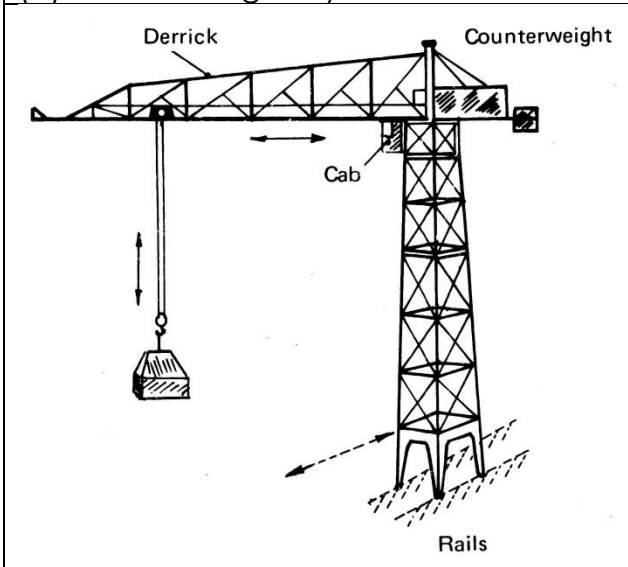
(b) Gantry crane



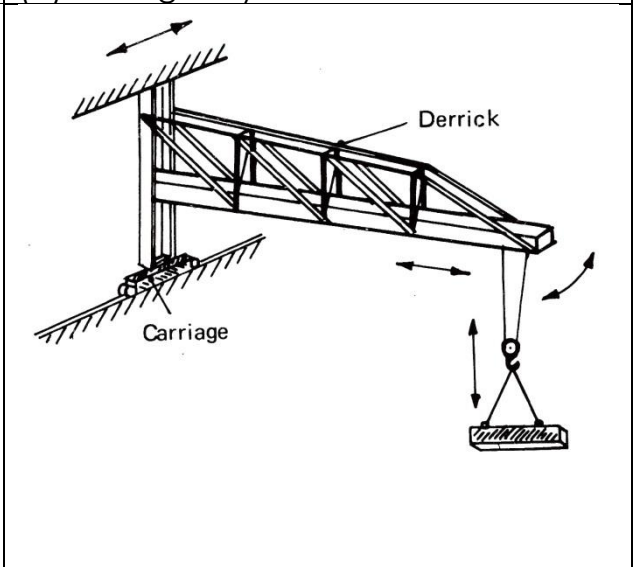
(c) Cantilever gantry crane



(d) Semi-gantry crane

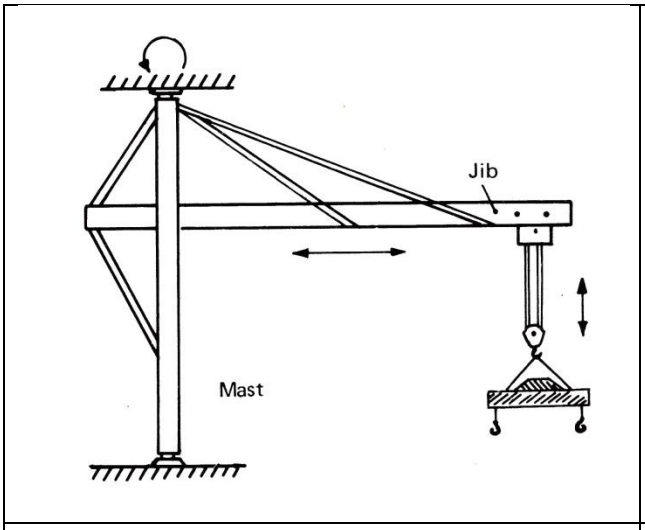


(e) Hammerhead crane

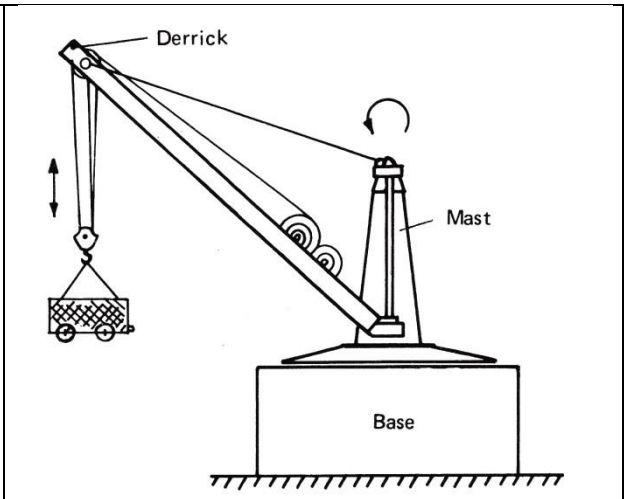


(e) Hammerhead crane

Figure 8.1 Types of cranes



(g) Jib crane



(g) Jib crane on a concrete base

Figure 8.1 Types of cranes

The simplest crane of all consists of a single-grooved wheel, over which the rope is passed, suspended from a scaffold or beams and is called a gin wheel.

The gin wheel is manually operated and always requires more effort than the weight of the load to raise it to the required height. It is only suitable for light loads as, for example, a bucketful of mortar and is normally only used on very small contracts.

Apart from these simple cranes for small loads most cranes come in the more recognisable form. Subdivision of crane types can be very wide and varied but one simple method of classification is to consider cranes under THREE general headings:

1. Mobile cranes.
2. Static or stationary cranes.
3. Tower cranes.

Static cranes are also often called stationary cranes. As both names imply, are these cranes fixed to one position where they will remain until the end of the contract. When choosing the position for a static crane the most important consideration is the reaching range. It is fixed at its working position to a base and after completion of the works it is dismantled, transported and re-erected on another site. Tower cranes and guyed derrick cranes are typical static cranes.

A tower crane is the same as a cantilever crane. It consists of a long vertical part, the tower and a fully rotating horizontal cantilever, the slewing jib.

Cranes which are secured to the rising structure are supported cranes. Those which are anchored to a concrete base- only are self-supporting cranes.

A climbing crane is a supported cantilever crane with a short tower which is fixed into a lift shaft or similar. Ii moves up as the building reaches height.

8.3 General purpose uses and of cranes

The general purpose and use of cranes are:

- Vertical movement and displacement. A crane can lift a load from the ground to the roof of a building.
- Horizontal movement and displacement. A crane can lift a load from one spot in the workplace and move it to a different spot in the same workplace.
- To transport loads from one site to another.
- To load and unload railway trucks, ships, containers or trucks.

The FOUR types of cranes that we will discuss in this module are:

1. Overhead travelling cranes,
2. Tower cranes,
3. Wharf cranes, and
4. Mobile cranes.

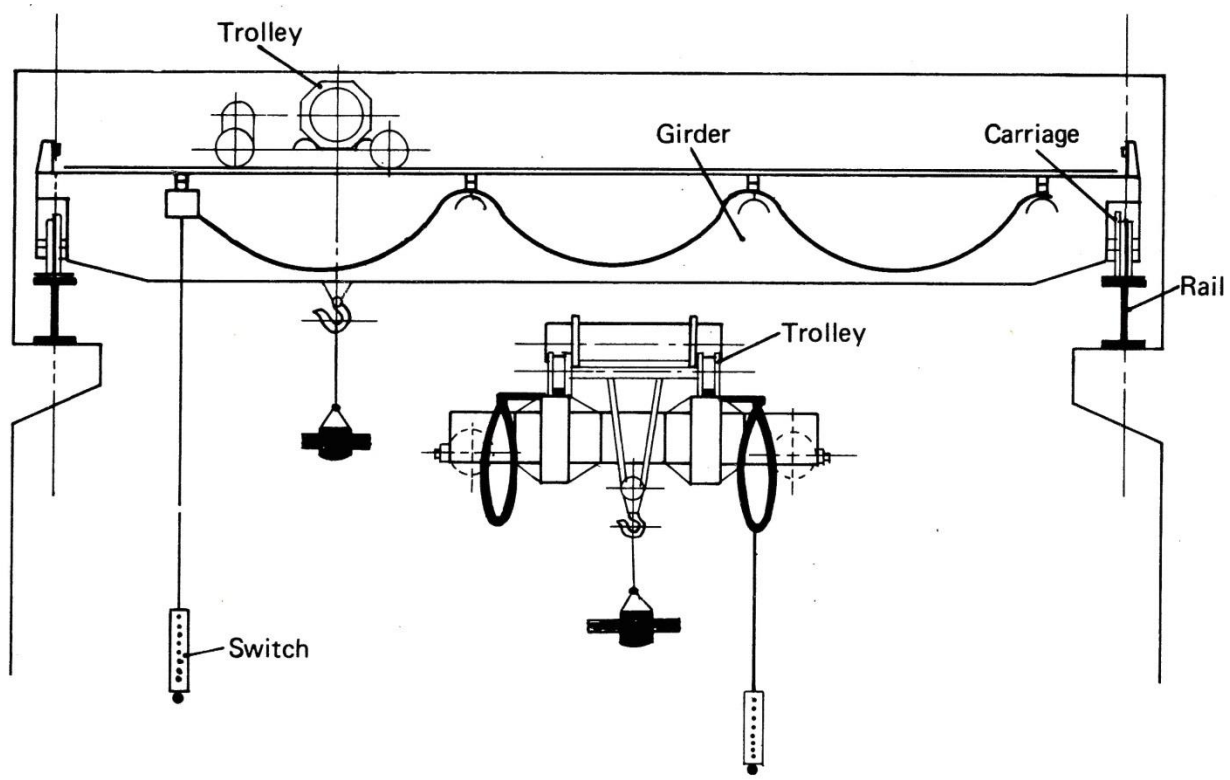
8.4 Overhead travelling cranes

Overhead electric travelling cranes are basically similar in design, all having to perform the same functions. They must be able to hoist a load and travel with it longitudinally or transversely.

These operations are commonly termed:

- Hoisting,
- Long-travel and
- Cross-travel or traverse.

Hoist motion where the crane lifts or hoists a load.
Long travels where the crane transports a load longitudinally by moving along its rails or track. The load can thus be transported along the length of the workshop.
Cross travel where the crane can transport a load in a transverse direction, along the length of the frame of the crane by the trolley.



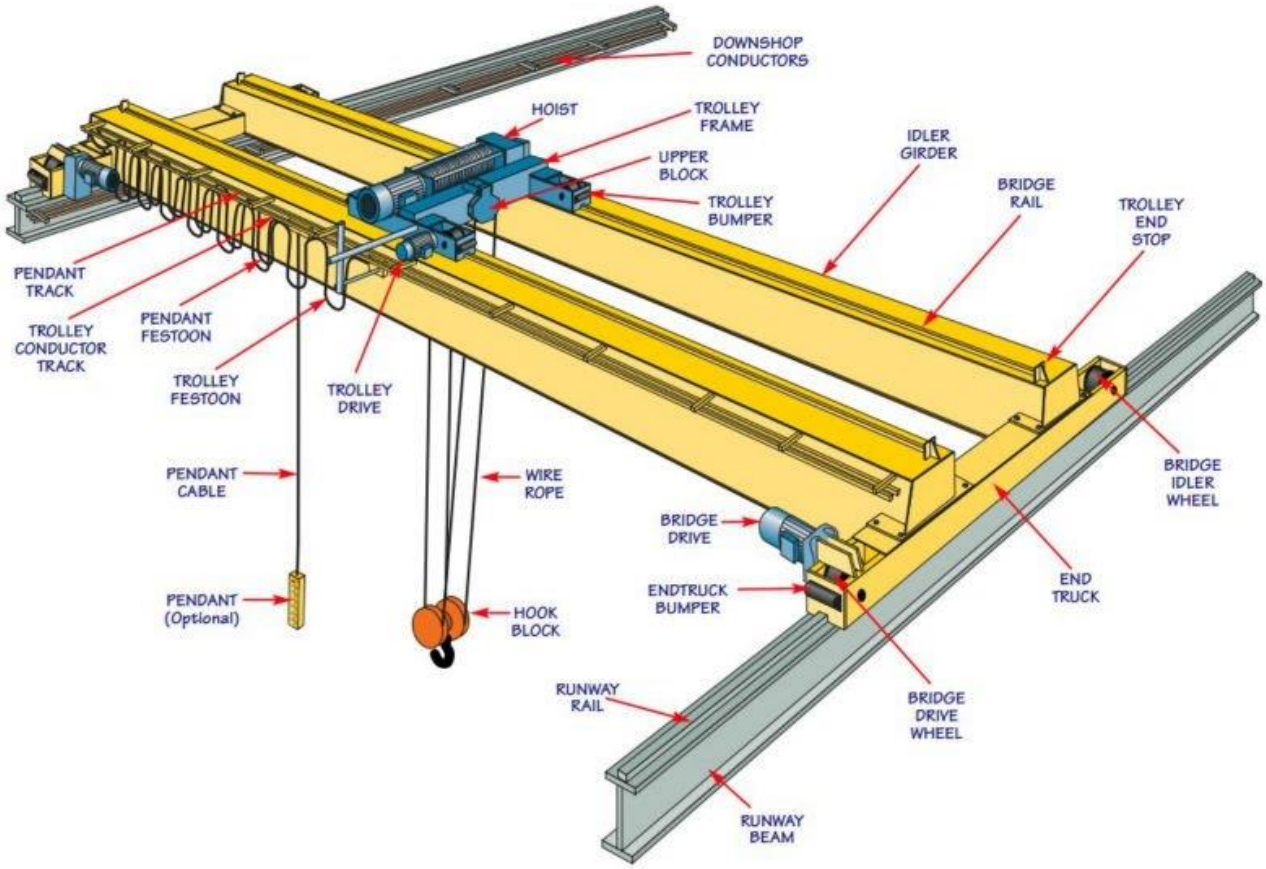


Figure 8.2 Overhead travelling crane

DID YOU KNOW

An **overhead crane**, commonly called a bridge crane, is a type of crane found in industrial environments. An overhead crane consists of parallel runways with a traveling bridge spanning the gap. A hoist, the lifting component of a crane, travels along the bridge. If the bridge is rigidly supported on two or more legs running on a fixed rail at ground level, the crane is called a gantry crane.

The advantages and disadvantages of an overhead travelling crane are:

Advantage	Disadvantages
• It is a very versatile type of crane. It can move a load in any direction, up or down, across or along a workshop.	• The working area is limited to the length of the rail or workshop and the span of the crane.
• Overhead travelling cranes can be used to assist in the assembling process of a job.	• We can use the overhead crane only in the workshop or place where it is installed.
• It can be designed to carry extra heavy loads.	• Each overhead travelling crane has a limited load capacity. If a load exceeds this capacity, we cannot bring in a larger travelling crane.
• If we change the number of drops, we can obtain different speed ratios and mechanical advantages.	
• Because of the height of the d river's cabin, the driver has a clear view most of the time.	
• This type of crane can be equipped with a remote control in order to promote safety and productivity.	

8.4.1 Uses of overhead cranes

- The most common overhead crane use is in the steel industry. At every step of the manufacturing process, until it leaves a factory as a finished product, steel is handled by an overhead crane.
- Raw materials are poured into a furnace by crane, hot steel is stored for cooling by an overhead crane, the finished coils are lifted and loaded onto trucks and trains by overhead crane, and the fabricator or stamper uses an overhead crane to handle the steel in his factory.
- The automobile industry uses overhead cranes for handling of raw materials. Smaller workstation cranes handle lighter loads in a work-area, such as CNC mill or saw.

8.5 Tower cranes

In the building industry, tower-lift cranes are used for the handling of material on the building site. Tower cranes may be classified as follows according to the method of mounting: static on a base, on a bogie that runs on rails, or the climbing type.

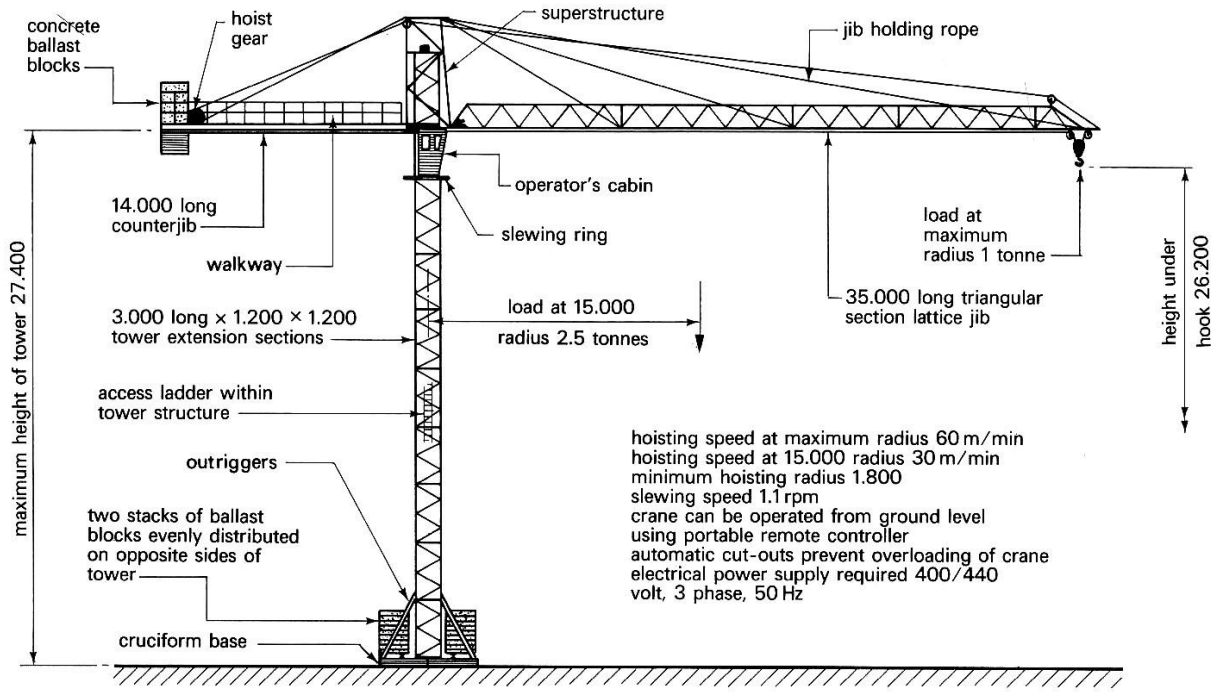


Figure 8.3 Typical self-supporting static tower crane

The advantages and disadvantages of a self-supporting tower crane are:

Advantage	Disadvantages
• The crane occupies a limited area.	• The covering area of the crane is limited because it is fixed in one position.
• It can be set at varying heights up to its maximum free-standing height. By free-standing height we mean the height which the crane can reach without needing support.	• The crane is static and cannot move around while it is in operation.
• It can be extended beyond the free-standing height using the structure it is building to support the crane.	• The crane's capacity decreases as the operating radius increases.
	• The costs of operation such as erection, dismantling and transport are very high.

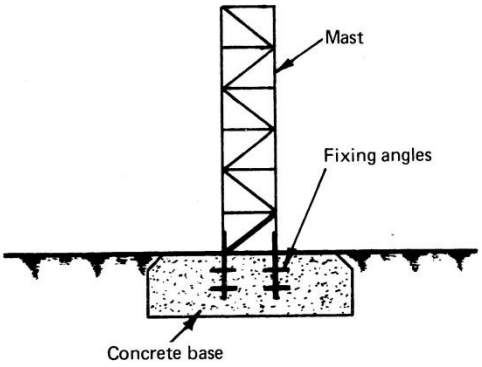


Figure 8.4 Static mounting of a tower crane

Tower cranes are especially designed to handle building materials during the construction of a building. Tower cranes are classified according to the way they are mounted.

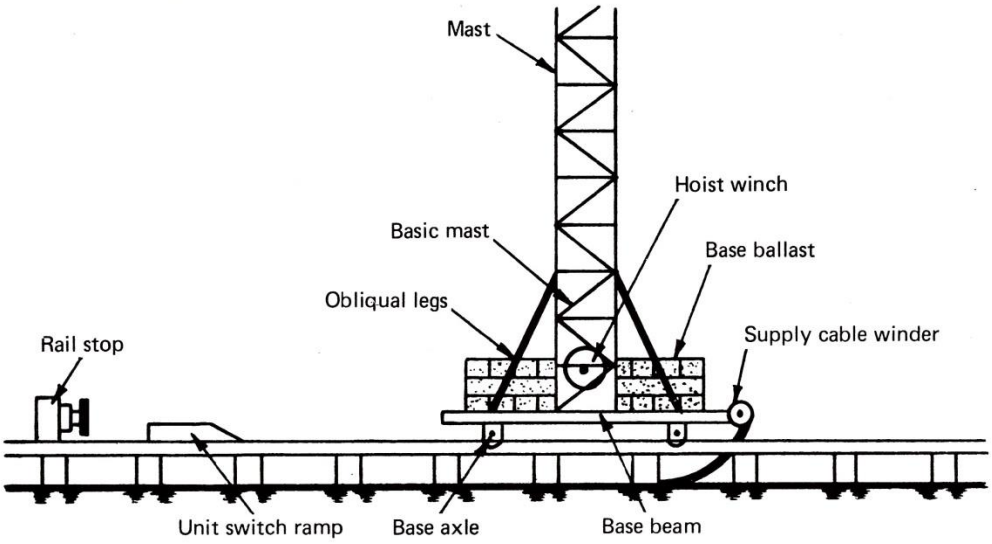


Figure 8.5 Rail mounted tower crane

8.5.1 Travelling tower cranes

To obtain better site coverage with a tower crane a rail-mounted or travelling crane could be used. The crane travels on heavy wheeled bogies mounted on a wide gauge (4.200) rail track with gradients not exceeding 1 in 200 and curves not less than 11.000 radius depending on mast height.

It is essential that the base for the railway track sleepers is accurately prepared, well drained, regularly inspected and maintained if the stability of the crane is to be ensured.

The motive power is electricity, the supply of which should be attached to a spring loaded drum which will draw in the cable as the crane reverses to reduce the risk of the cable becoming cut or trapped by the wheeled bogies.

Travelling cranes can be supplied with similar lifting capacities and jib arrangements as given for static cranes (See **Figure 8.6** for typical example)

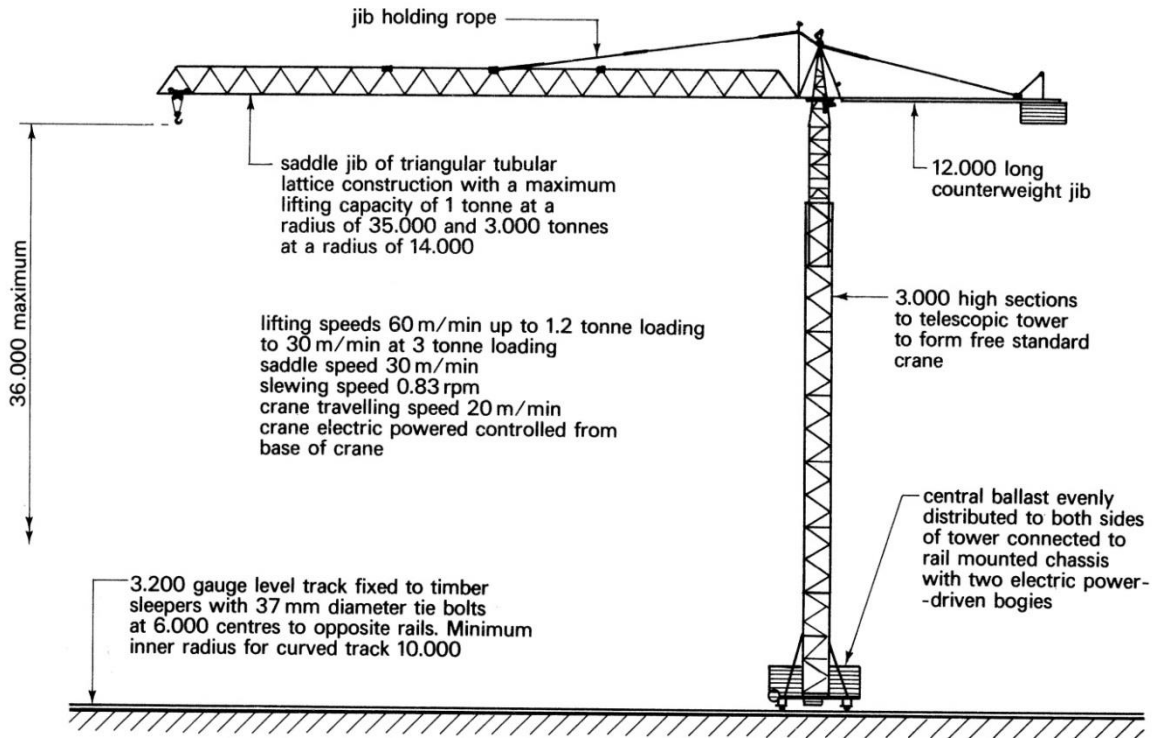


Figure 8.6 Typical travelling tower crane

8.5.2 Climbing cranes

They are designed for tall buildings being located within and supported by the structure under construction. The mast which extends down through several storeys requires only a small (1.500 to 2.000 square) opening in each floor.

Support is given at floor levels by special steel collars, frames and wedges. The raising of the static mast is carried out using a winch which is an integral part of the system.

Generally this form of crane requires a smaller horizontal or luffing jib to cover the construction area than a static or similar tower crane. The jib is made from small, easy-to-handle sections which are lowered down the face of the building, when the crane is no longer required, by means of a special winch attached to one section of the crane. The winch is finally lowered to ground level by hand when the crane has been dismantled (See **Figure 8.7** for typical crane details).

DID YOU KNOW
The climbing-type tower crane is moved upwards with the building as it is built higher and higher. We say that it 'climbs' with the building.

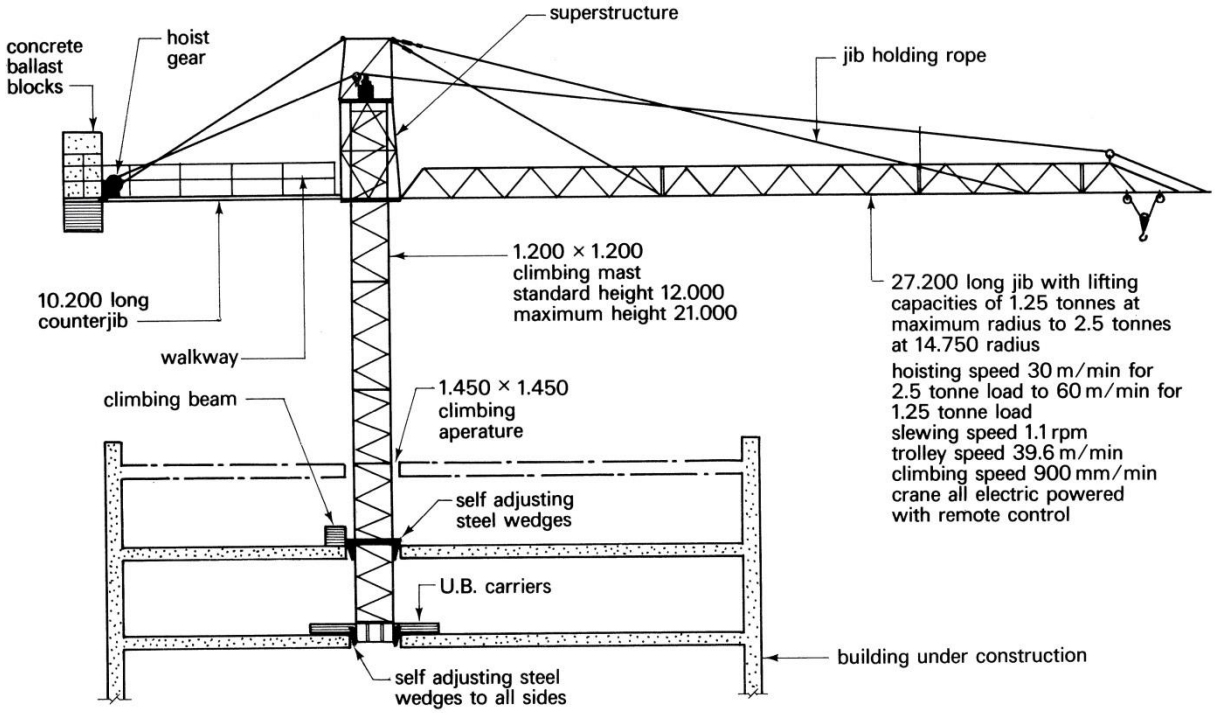


Figure 8.7 Typical climbing tower crane

The advantages and disadvantages of a climbing tower crane are:

Advantage	Disadvantages
• In theory, there is no limit to the height of a building that can be built in this way. The crane is simply moved up floor by floor as the building progresses	• It is a time-consuming process to erect and to dismantle the crane.
• This crane has no effect on the traffic in the surrounding streets or roads.	• The erecting and dismantling processes are very costly.
• The operator of the crane has a clear view of the construction of the floor.	• The cranes are very tall. Lightning and windy conditions may cause a hazard to personnel on the site, the public and the property.
• This crane is used to good advantage when the building structure is high and the side area limited.	• You need more planning than usual when using a climbing-type tower crane because of its structure, foundations and presence on the site.
• The structure of the erected building itself supports the crane.	• The operator at times may be quite far from the point of operation. Under these conditions, misjudgement and misunderstandings can lead to

	serious accidents.
	• The crane cabin is very high. This can cause a dangerous situation for the operator if an accident occurs.
	• If you exceed the load limits, excessive stresses on the whole crane structure occur. This can lead to fatal accidents.
	• In very cold weather structural members can fail suddenly.

8.6 Mobile cranes

Mobile cranes are actually power jib cranes, mounted on a mobile chassis and capable of moving from one place to another under their own power.

The power which actuates both the crane and the vehicle is supplied by an internal combustion engine (petrol or diesel) and the power transmission systems according to which the cranes are classified into THREE types:

- Electric,
- Hydraulic or
- Mechanical.

Figure 8.8 Typical mobile crane

Mobile cranes are built not only to hoist heavy loads, but are also built with jibs with a reach of over 50 metres. The jibs can be fixed or telescopic. Mobile cranes fitted with long jibs are used for lifting loads to great heights.

Because of the length of the jib it also has a longer reach enabling it to reach loads which are far from the crane. Some mobile cranes are designed for easy handling in traffic on streets and also on country roads.

These cranes thus comply with the requirements laid down in the provincial Road Traffic Ordinances.

Jib: The projecting arm of a crane.
Boom: A movable arm of a crane.
Telescopic: Made of parts that slide into one another.

8.6.1 Travelling in mobile cranes

Should doubt exist as to whether the ground over which the crane is to travel will be able to support the mass of the crane, matting must be used. Scrap steel plates or wooden beams may also be used for this purpose.

SAFETY HINTS and PRECAUTIONS for Crane Operators

Have a look at some safety precautions and safety measures:

- Steel plates with sharp or protruding points which are likely to damage the tyres should not be used.
- Crane drivers should never allow themselves to be distracted while operating the crane.
- Cranes should never move closer than approximately 2 metres to any electric overhead conductor.
- Never drag a load sideways when slewing. Any dragging causes abnormal stress on the structure of the crane with possibly serious detrimental results. There have been cases where jibs were torn out of their stays as a result of dragging when slewing.
- If the load is inclined to sway when it is moved, a rope should be fastened to one end of the load to enable a responsible person to control the movement of the load.
- If the jacks are not firmly secured and raised as high as possible, they may be torn off or damaged if they hook on some obstruction accidently.
- Always keep a close watch for persons who are working with you or who may be working in the vicinity.
- It is dangerous to travel in cranes over uneven terrain with the jib luffed out, because it can easily cause the crane to topple over. This applies equally to cranes with strut-type and hydraulic-type jibs. Before moving the crane the hydraulic jib should be drawn in as far as possible and positioned over the crane cabin. In this regard the manufacturer's instructions should be complied with strictly.
- Before travelling in a crane, the lock pin for the slewing motion should be placed in position.

8.6.2 Terms commonly used

Condition of tipping: A crane is in the condition of tipping when it is supporting a load and it is impossible to increase this load by even a small amount without causing the crane to fall over.

Height of lift: This is the vertical distance between the floor level (or datum level) and the lowest point of the throat of the hook when the hook is in the highest working position.

Jib length: This is the shortest distance between the fulcrum of the jib and the centre of the jib head pulley.

Outreach: This is the horizontal distance from the centre line of the lifting hook to the nearest point of the machine other than the jib.

Outrigger (supporting feet): Mobile cranes are equipped with jacks or outriggers on the four corners of the chassis to prevent them from toppling over when lifting heavy loads. The lifting capacity is therefore considerably increased.

Figure 8.8 shows a self-propelled strut jib crane.

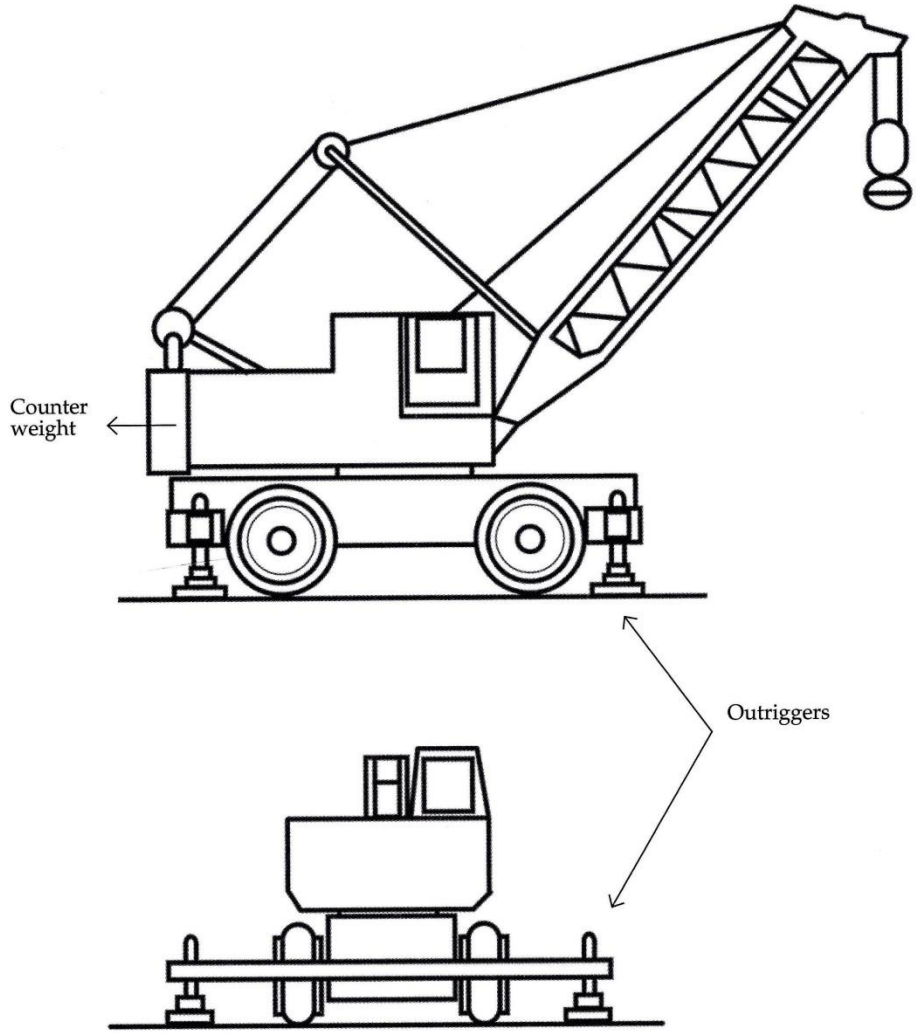


Figure 8.8 Self-propelled mobile crane

8.6.3 Counterweights on mobile cranes

The crane counterweight is critical for ensuring crane stability. A counterweight that is too light for a load and boom configuration will cause the crane to overturn in the direction of the suspended load.

A crane can also fall over backwards due to the effect of the counterweight in situations when:

- the counterweight is too heavy for the boom configuration
- the crane is travelling up a slope with the boom luffed up
- inadequate timbers are placed under the outrigger pads below the counterweight when the crane is positioned on soft ground
- outriggers are not extended or lowered into position.

On most of the smaller mobile cranes, the counterweight is fixed and cannot be easily removed. However, on an increasing number of larger cranes some of the counterweights are designed to be removed for road travel or when smaller boom and lifting configurations are required.

In this situation, it is particularly important to attach the correct type and number of counterweights to the crane for the particular lift to be undertaken.

Counterweights must be secured to the crane in the manner specified by the crane manufacturer. Where counterweights are removable, each counterweight must be clearly and permanently identified with the crane manufacturer's name or trademark and the mass of the counterweight (preferably in tonnes).

Where the crane is fitted with a rated capacity limiter, the data input into the computer must be correct for the counterweight configuration on the crane and related to that shown on the appropriate load chart. This also applies to the boom configuration being used on the crane.

8.6.4 Truck-mounted cantilever jib mobile crane

This crane has a boom that is of a lattice construction and is used as a yard crane. It can travel with bulky loads as the jib is pivoted at a much higher position. **Figure 8.9** shows a truck-mounted cantilever jib crane.

Truck-mounted cranes have a greater mobility on the road, but are less mobile on site. Their primary use is 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 so that the low-mounted jib does not foul the top of the building.

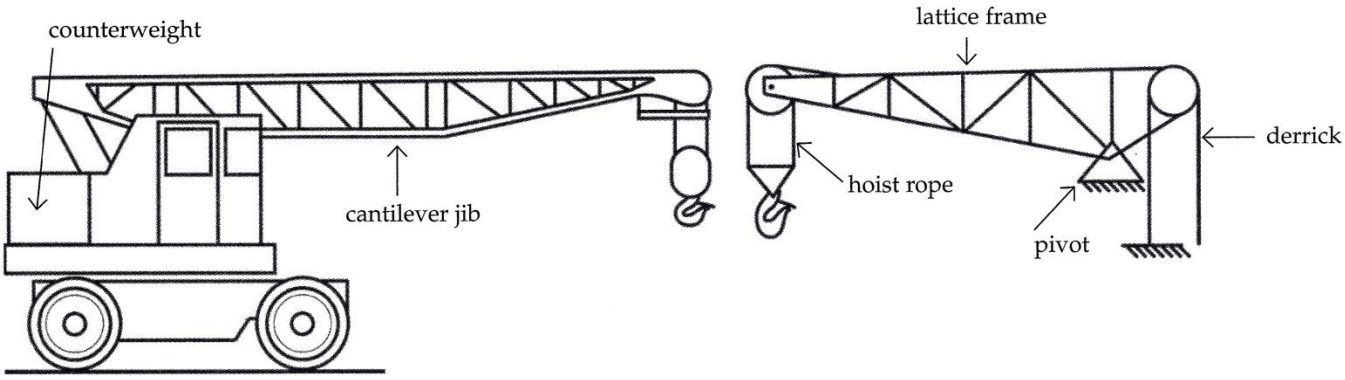


Figure 8.9 Truck mounted cantilever jib mobile crane

8.6.5 Crawler-mounted mobile cranes

These cranes are versatile cranes for site use. They can operate on soft swampy ground and can be converted to grab or drag line.

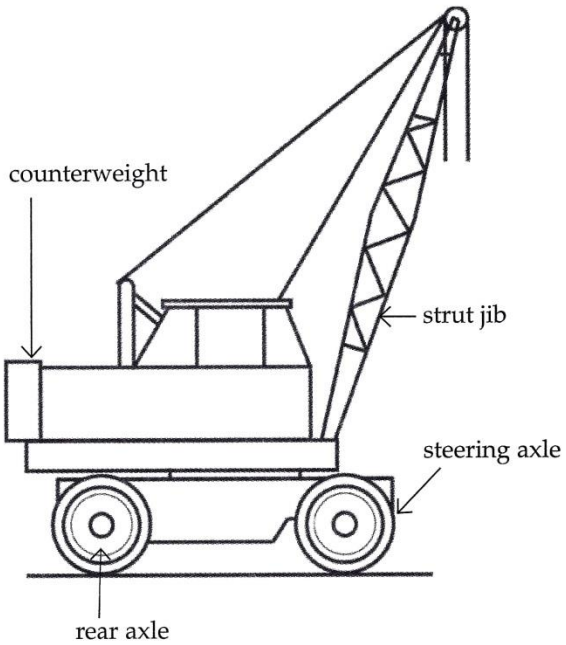


Figure 8.10 Crawler-mounted mobile crane

8.6.6 Selecting a mobile crane

The rated lifting capacity of a crane is the load it can lift with the shortest jib at minimum radius, that is, as close as possible to the crane without riggers fully extended.

When selecting a mobile crane for a job, the size and characteristics of the crane should be assessed against the following criteria:

- The weights, dimensions and lift radii of the heaviest and largest loads to be lifted

- The maximum lift height and radius, and the weight of the loads to be handled at these points
- The number and frequency of lifts to be made
- How long the crane will be required at the workplace
- The type of lifting to be done
- The type of carrier required - this depends on ground conditions and machine capacity in its various operating quadrants
- Whether loads are to be suspended for lengthy periods of time
- The workplace conditions, including the ground on which the crane is to be set up, access roads and ramps it must travel on, space for erection and any obstacles that may prevent access or operation.

8.6.7 Boom selection for cranes

- **Cantilever jibs**

These are suitable for self-propelled and truck-mounted cranes (see **Figure 8.9**).They give greater clearance where headroom is limited, particularly when handling bulky loads.

Lifting capacity is generally lower than for a comparable size strut jib crane because of the need to carry the weight of the cantilever boom. For permanent site-based work, the crawler strut jib crane tends to be more economical for construction work. The cantilever jib is used mainly for stockyards where manoeuvrability and headroom are restricted.

- **Strut jibs**

Strut jibs are used with derricks, crawler cranes and truck-mounted cranes (see **Figure 8.8**). They have a high lifting capacity with long reach but are cumbersome and require dismantling to increase the boom length or to add fly jibs. The strut jib is the preferred boom on the dragline and grabbing crane.

Fly jib

A fly jib may be attached to either a strut jib or a cantilever jib to provide extra reach. It is usually used offset from the main boom for construction work to increase the working radius for a given jib angle. It is also useful for placing concrete, reinforcement and other light loads (see **Figure 8.11**)

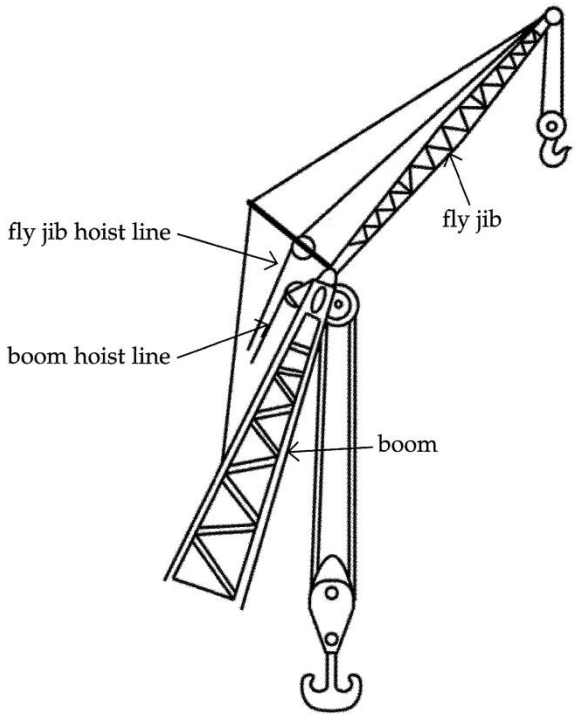


Figure 8.11 Fly jib

- **Telescopic jib**

The telescopic jib is a variation of the cantilever boom. It offers a quickly operational and variable length jib. It is restricted to self-propelled and truck-mounted cranes and cannot handle dragline and grabbing duties.

The weight of the telescoping rams reduces the weight and radius capacity compared to the strut jib, but offers increased manoeuvrability. This is an expensive type of crane.

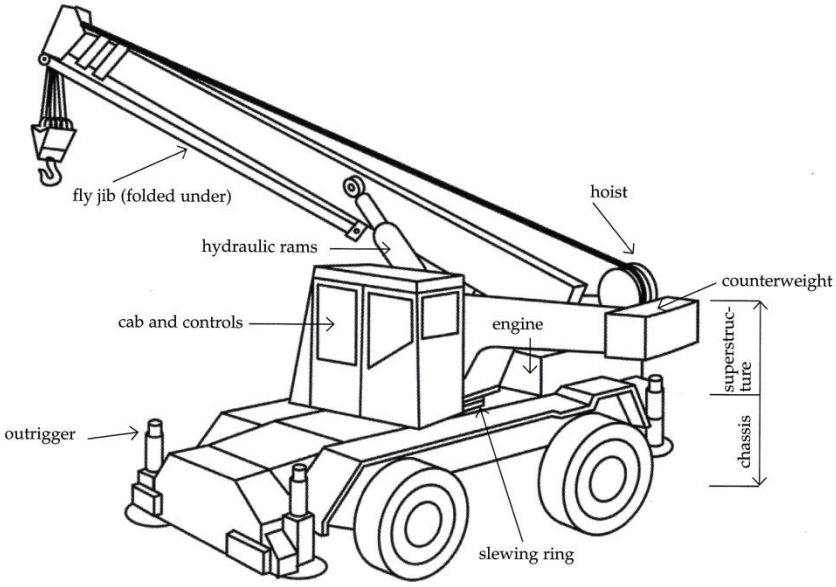


Figure 8.12 Telescopic jib

The advantages and disadvantages of mobile cranes are:

Advantage	Disadvantages
• They can move from point A to point B under their own power while carrying a load.	• If the crane travels over an uneven surface with a heavy load, the crane can topple over.
• Mobile cranes are allowed to move from one stand to another on public roads, as long as they comply with certain traffic regulations.	• A common crane accident occurs when the jib is pulled backwards over the top of the cabin.
• Heavy loads can be lifted to great heights.	• Strong winds can create forces sufficient to topple the jib.
• The crane jib can reach and pick up loads far from the crane.	• The operator's view is often restricted because of the nature or size of the job or operation.
• Because mobile cranes can move forward and backward under their own power, heavy loads can be reached and removed from difficult to reach places.	

8.7 Wharf cranes

A wharf crane is a type of crane designed and adapted to the loading and unloading of ship loads. Although some cranes can handle heavy loads, wharf cranes with a safe lifting capacity of four tons are generally-used.

The Wharf cranes are mounted on rails and can therefore travel along the wharf.
Often several cranes are used next to one another to unload or load cargo on the same ship.

The under frame of wharf cranes is of such a width and height that fully loaded trucks can pass underneath the cranes with ease. Another reason for this is to ensure that the jib will always project at a sufficient height above the sides of large ships.

Wharf cranes are usually driven by electric motors. There is one motor for each movement.

These movements are the following: longitudinal travel, slewing motion, luffing motion, and raising and lowering of the crane hook. Longitudinal travel is when the crane travels along the wharf on its rails to take up position alongside a ship.

A slewing motion occurs when the machine room, driving cabin and jib can swivel on the under frame. It is therefore possible to swivel with a load from a ship in order to place the load on the wharf.

A luffing motion is when the jib which swivels on a heel pin is luffed further out from the centre of the crane, or is luffed in to suit the position of the load being lifted. A hoisting motion is when the crane hook to which all loads are hooked is suspended from a steel cable which is raised or lowered to lift or lower loads as required.

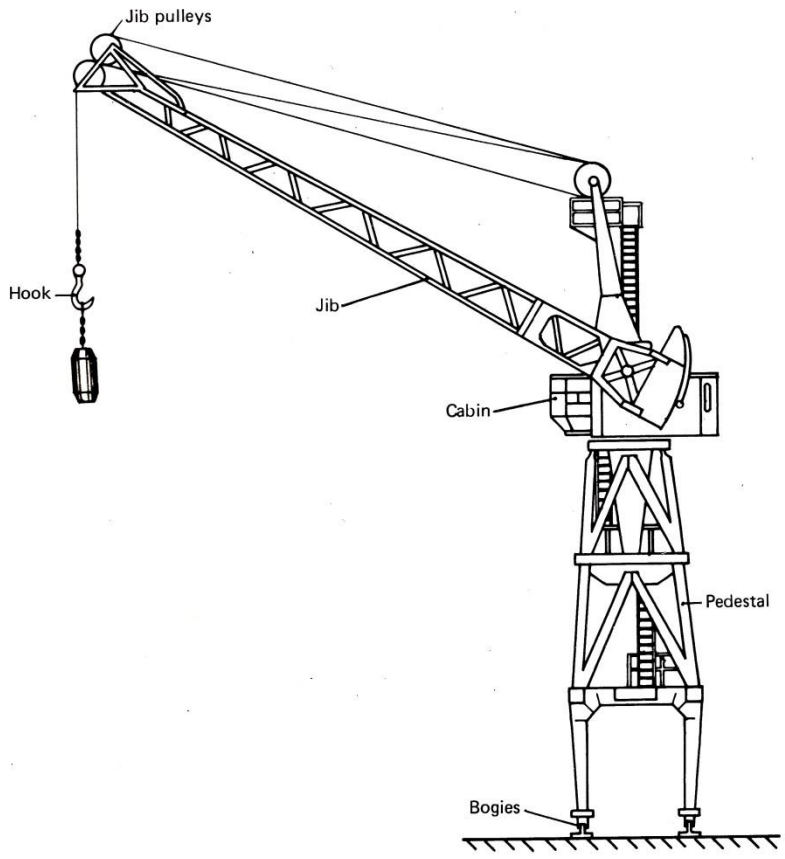


Figure 8.13 Wharf crane

The advantages and disadvantages of Wharf cranes are:

Advantage	Disadvantages
• It can transport loads on a rail between two points alongside the wharf.	• If the Wharf crane travels over an uneven surface with a heavy load, the crane can topple over.
• It can handle very heavy loads as well as very big lighter loads.	• Only used in shipping harbours.
• It does not disturb traffic on the wharf because fully loaded trucks can pass underneath the crane.	• Strong winds can create forces sufficient to topple the jib.

8.8 Lifting attachments for cranes

Figure 8.14 shows the lifting attachments for cranes

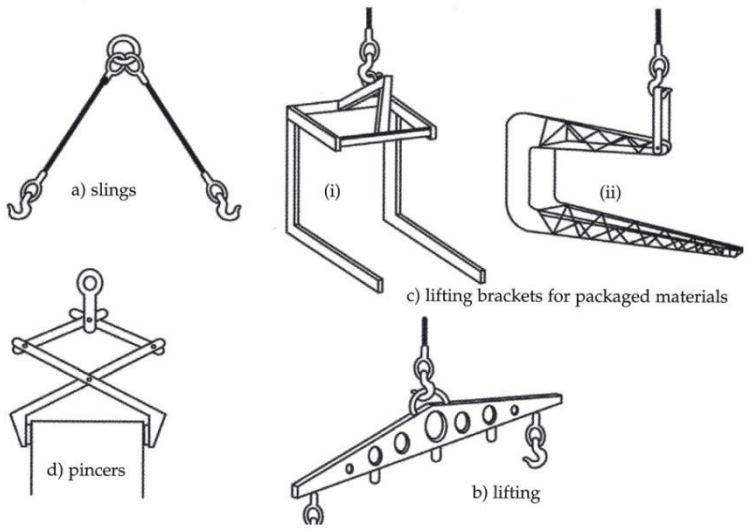


Figure 8.14 Lifting attachments for cranes

8.8.1 Slings

A sling is an assembly that connects the load to the material handling equipment. Slings are used widely for moving bundles of reinforcement, timber, steel and concrete beams and pre-cast concrete units.

The safe working load for two-legged slings is generally quoted at 90°, since the lifting capacity varies with the angle of the legs. For example, a two-leg wire sling of 19 mm diameter will carry 5 280 kg at 60°, 4 300 kg at 90° and 3 050 kg at 120°. The capacity of the equivalent single-leg sling is 3 050 kg.
The two main types of slings are:

- wire rope slings
- chain slings.

8.8.2 Wire rope slings

A wire rope consists of a number of steel strands wound around a core. **Figure 8.15 (a)** shows a steel rope and **Figure 8.15 (b)** shows the construction of a wire rope.

Figure 8.15 (a) Steel rope

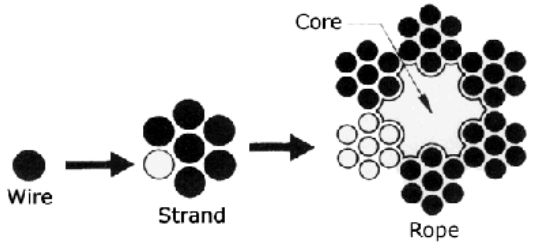


Figure 8.15 (b) Construction of a wire rope

8.8.3 Checking a wire rope or sling

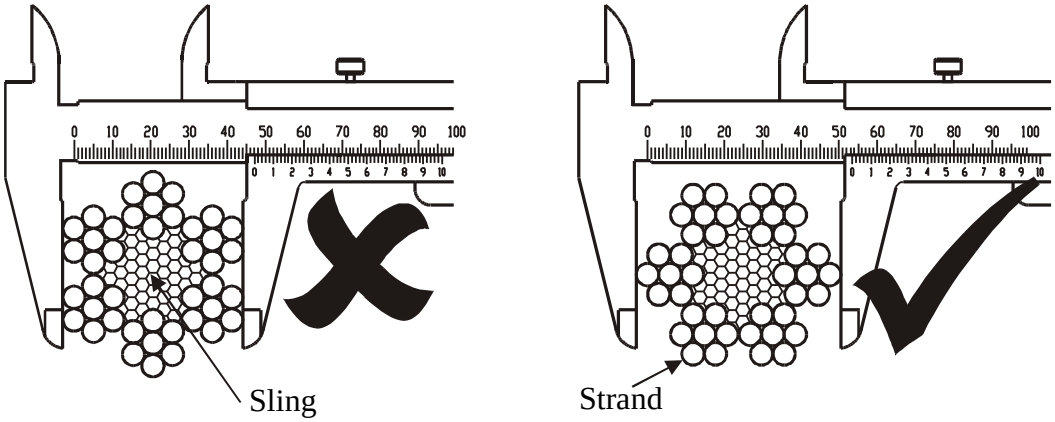
Any rope or sling showing the following defects must be discarded by means of cutting up and disposal.

- **Broken wires**

There must not be more than six broken wires in a sling.

- **Wear**

There's only one right way to measure rope diameter: use a vernier and be sure to measure the widest diameter. The drawing shown in **Figure 8.16** shows the right way with the wrong way.



Correct method of checking a sling diameter

Figure 8.16 Correct and incorrect method of checking a sling's diameter

This method is not only useful for measuring the diameter of a new rope, but also for determining the amount of wear and compression that has occurred while the rope has been in use. Accurate recording of this information is essential in helping to decide when to replace wire rope.

The sling must not be worn by more than 10% of its nominal diameter.

SAFETY HINT
Safe operating practices for selecting slings

1. Determine weight of the load.
2. Select the sling having suitable characteristics for the type of load, hitch and environment. Shock loading must be avoided.
3. Never use a sling that is rated lower than the load being lifted. Slings that appear to be damaged must not be used unless inspected and accepted.
4. Slings with fittings which are used in a choker hitch must be of sufficient length to assure that the choking action is on the webbing and not on a fitting or splice.
5. Slings used in a basket hitch must have the load controlled to prevent slippage.

6. Slings must always be protected from being cut by sharp corners, sharp edges, protrusions or abrasive surfaces with protection sufficient for the intended purpose.
7. Slings must never be twisted or tied into knots, or shorten or joined by knotting.
8. The sling must be hitched in a manner that provides total control of the load.
9. The operator and all other personnel must stand clear of the suspended load. No riding on the load must take place.
10. Place blocks under load prior to setting it down, to allow removal of the sling, if applicable.

8.9 Lifting Equipment

When a load is to be lifted it is usually coupled to the crane hook by wire cables or chain slings. Loads lifted by means of a single sling of wire cables, chain or fibre ropes, should not be heavier than the mass stamped on the sling washer or ferrule. (Each wire cable sling is provided with a sling washer showing the code number of the sling, date of manufacture and safe lifting capacity.)

8.9.1 Simple pulley system

In the pulley system shown in **Figure 8.17**, there are four sections of the rope supporting the load. The load is therefore shared between the four sections of rope.

If the operator were to pull the free end of the rope, the four required would be ¼ of the total load. Of course the force applied by the operator would be more because of friction.

On the other hand if the load were lifted 100 m, each of the four sections of the rope will have to shorten by 100 mm. The operator therefore, will have to pull the free end by 400 mm.

Energy is never created or lost.

There are four main types of chain block, namely, the spur geared, the screw-geared, the differential and the pull-lift types.

The first three types are used for hoisting in a vertical direction, whilst the last type is used primarily for pulling in a horizontal direction.

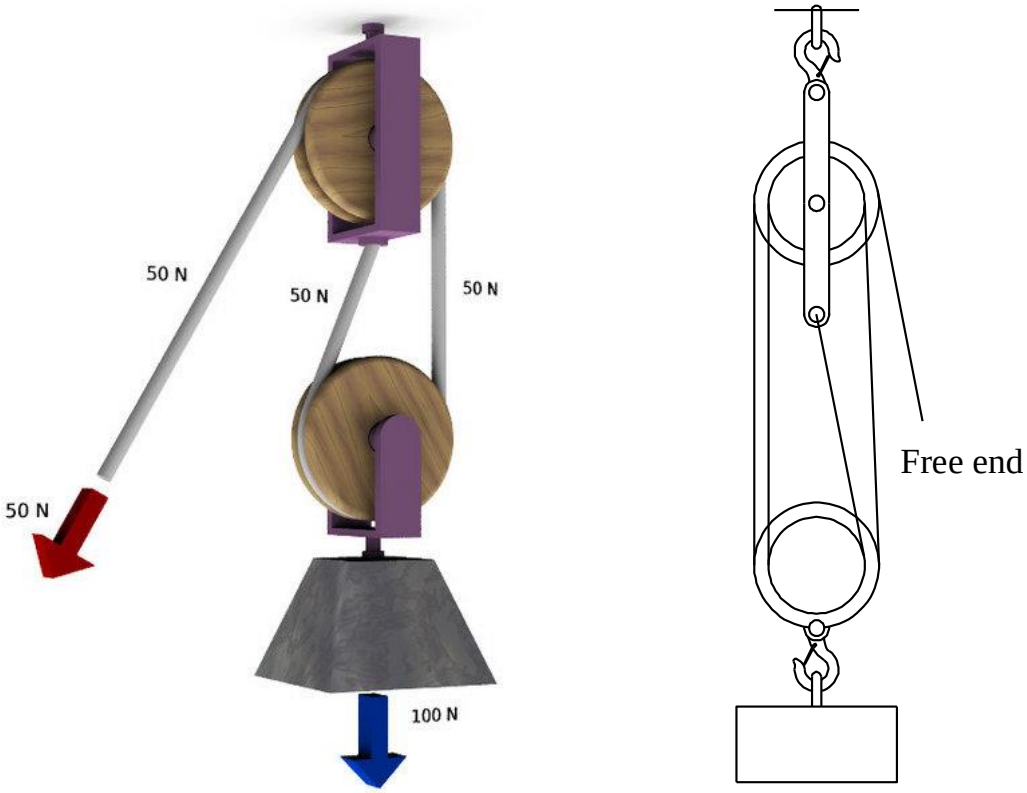


Figure 8.17 Simple pulley system

8.9.2 Differential pulley block

The top block contains two sheaves of different diameters, mounted together so as to form one piece.

The bottom block contains one sheave only. The chain is endless (one piece) and passes first round the larger top sheave, then round the bottom sheave and then round the smaller top sheave.

When raising or lowering the load the loose chain passing from the larger top sheave is pulled.

The chain itself fits into slots which are located in the two top sheaves only.
The load moves up S slots and downs slots.

This is the simplest and least expensive type of chain hoist, with an efficiency of about 30 %.

The mechanical advantage is gained by the two upper sheaves differing by one link slot so that more chain is racked in be the larger wheel to produce a net raising or lowering of the load.

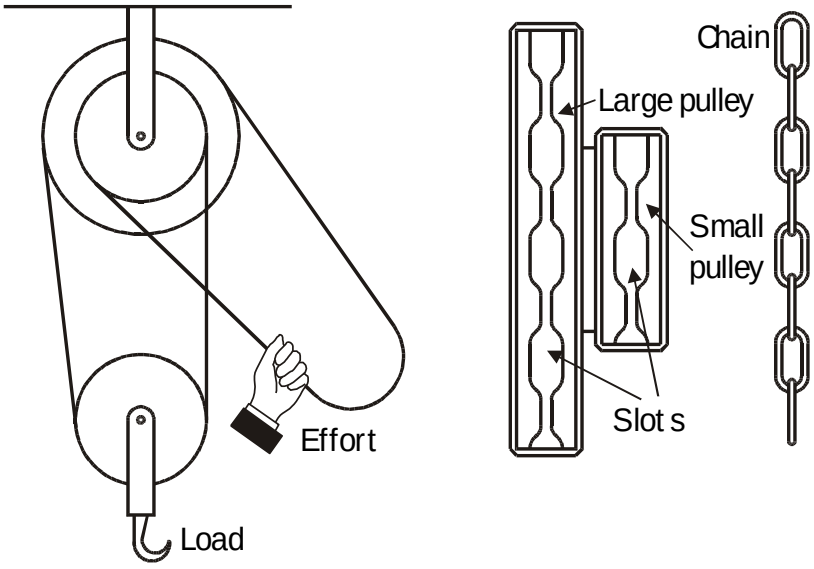


Figure 8.16 Differential pulley block

8.10 Winches

Cranes and some lifting tasks require a winch and rope drum to provide the lifting force. The winch maybe powered by electric motor, compressed air, hydraulic motor or a diesel engine.

The hoisting speed on most winches can be adjusted to accommodate the load being lifted.

For example a winch can handle 4000 kg at a speed of 100 m/min whilst the same winch will hoist a load of 20 000 kg at 20 m/min. **Figure 8.17** shows a typical winch arrangement.

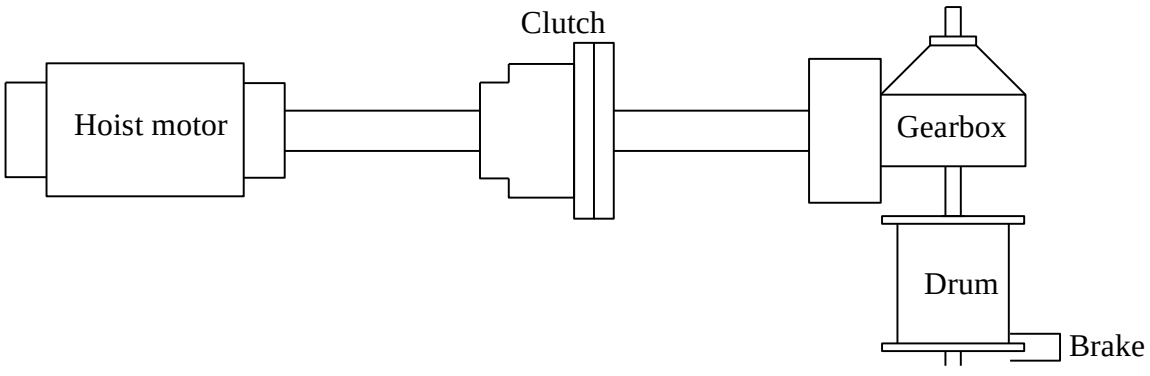


Figure 8.17 Typical winch arrangement

8.11 Rope blocks

To lift light loads a rope block can be used. Rope blocks can be of single or multi-rope type. These can be used to lift heavier hoisting equipment onto high beams so that heavier loads can be hoisted.

8.12 Chain block (block and tackle)

For frequent use and where a minimum of labour is available to operate it, the spur geared hoist is recommended. Although it has an initial high cost it is the most economical to use.

The screw geared and differential hoists have enough internal friction to prevent the load from running away on the lowering motion. Such is not the case with the spur geared hoist, so a load brake is incorporated into it.

The chain block (**Figure 8.19**) is portable, there are two types of chains used on a chain block, namely, the light chain is to operate the chain block and is called the messenger chain, if it is pulled at one end it will lift the load, if the other end is pulled it will lower the load.

Chain blocks are made with the bottom hook as the weakest part and this hook cannot be exchanged with the top hook. The reason that the bottom hook is made weaker is that any overloading will occur at this hook as it will tend to open.

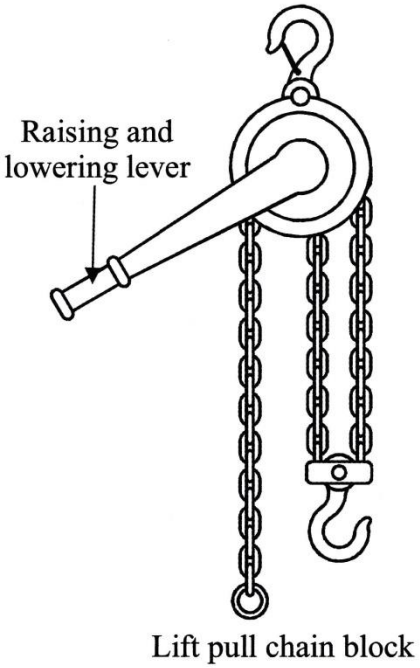


Figure 8.18 Lift pull chain block

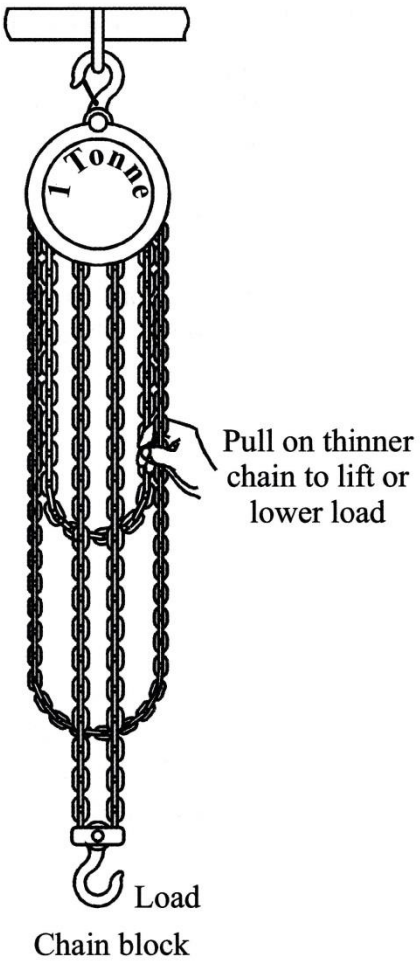


Figure 8.19 Chain block

8.12.1 Lift pull chain block

This type of chain block is portable and lightweight. It can be used to lift load vertically, horizontally or at any angle. This equipment is the riggers most valuable piece of assistance. It can also be used to pull, tension cable stays, and shifting loads.

The lift–pull chain block has a variety of uses:

- Shifting of rail trucks in mines
- Lifting loads on trucks
- Tensioning of stays
- Lifting pipes into manholes
- Construction industry

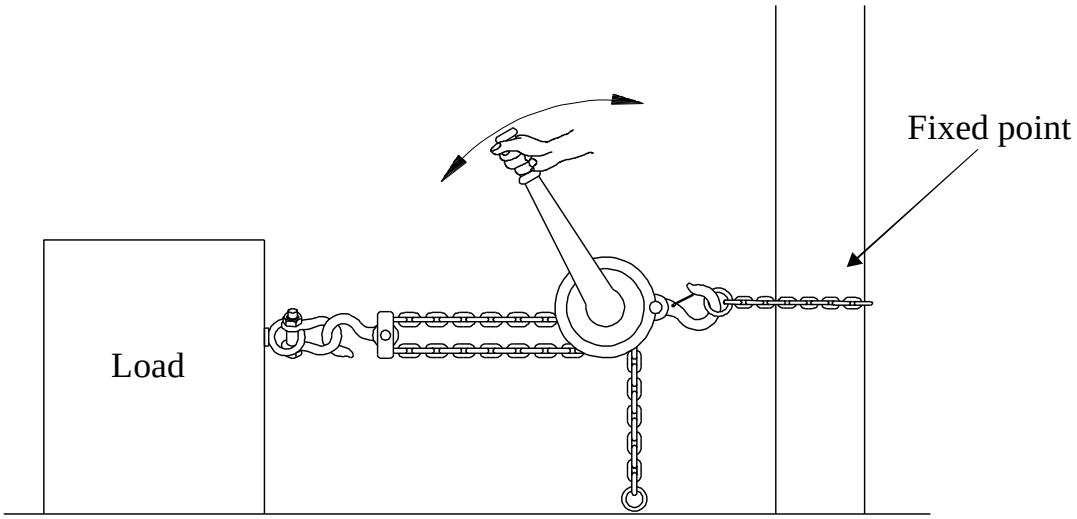


Figure 8.20 Lift pull chain block can be used to lift loads

8.13 Good slinging practice

1. Never work under an unsupported load. Make sure that trestles are used to support the load and not the hoisting equipment (**Figure 8.21**).

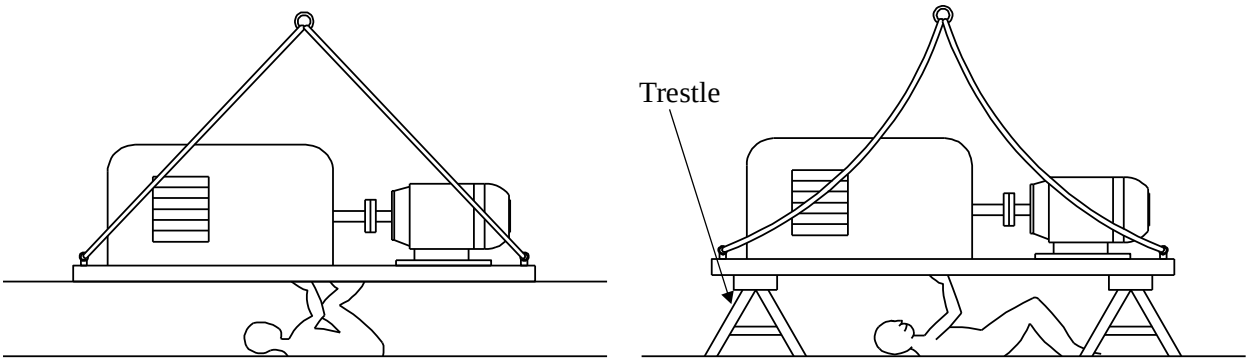


Figure 8.21 When working under a load always support it with trestles

2. Always be ready to land a load onto the site beforehand. Never rest the load on the slings but rather have wooden battens ready if required. This will allow for the easy retrieval of the slings from the load.

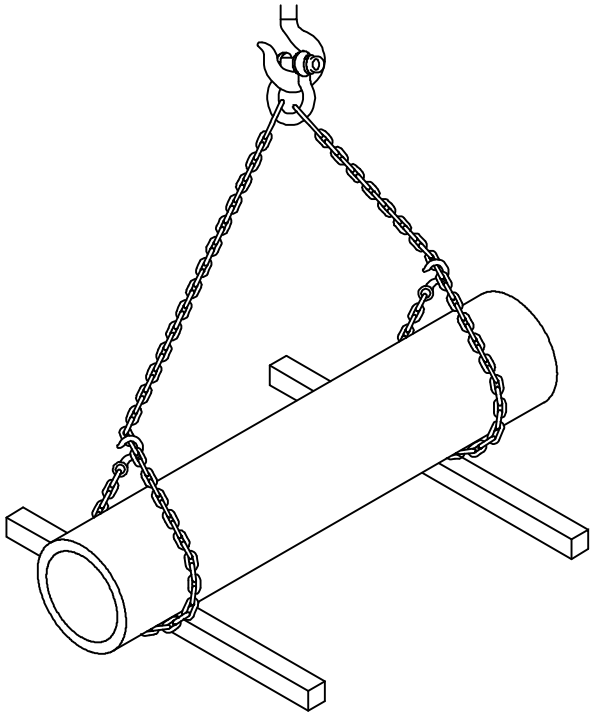


Figure 8.22 Use wooden battens

3. Use blocking or padding to protect hollow vessels (**Figure 8.23**), loose bundles and fragile items from scuffing and bending. Remember that blocking becomes part of the lift, and must be added to total weight on the sling.

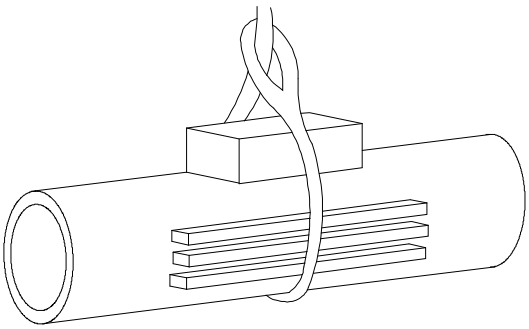


Figure 8.23 Blocking or padding used to protect hollow vessels

4. For long lifting loads use a tag line to control the load (**Figure 8.24**). The tag line is attached to the load and an operator pulls and eases the line as needed to keep the load from rotating etc.

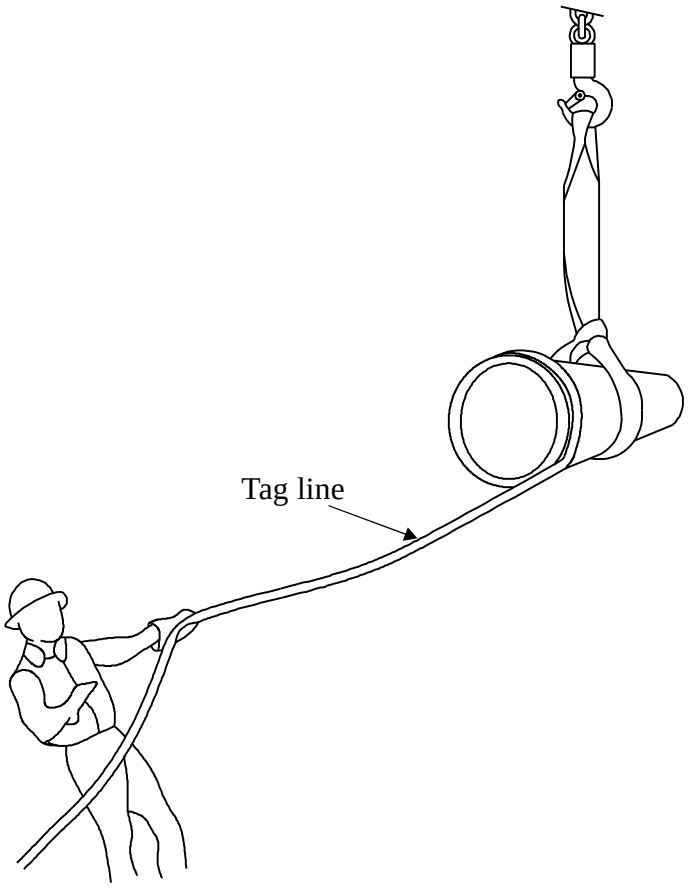


Figure 8.24 a tag line is used to control the load

5. Block loose loads before unhooking.

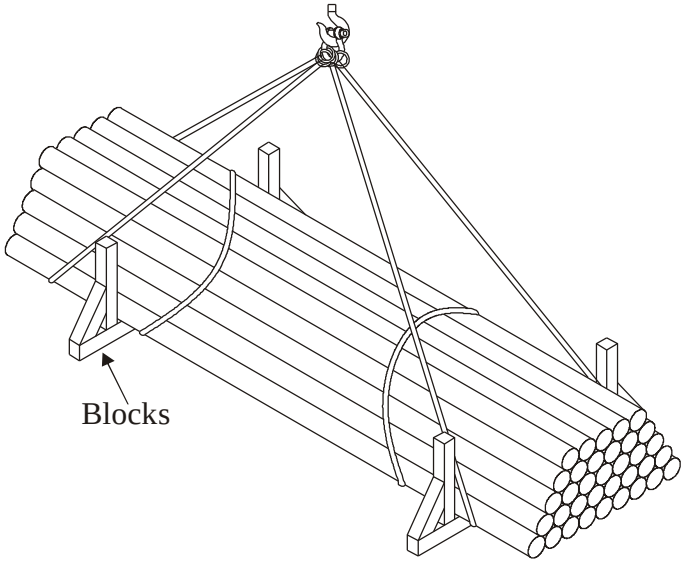


Figure 8.25 Blocks

8.14 Checking the working clearance and the sling length

After the mass and centre of gravity is determined, the clearance between the load and the lifting hook must be checked (also called the head room) to determine the length of the slings to be used and that the correct sling angles been maintained.

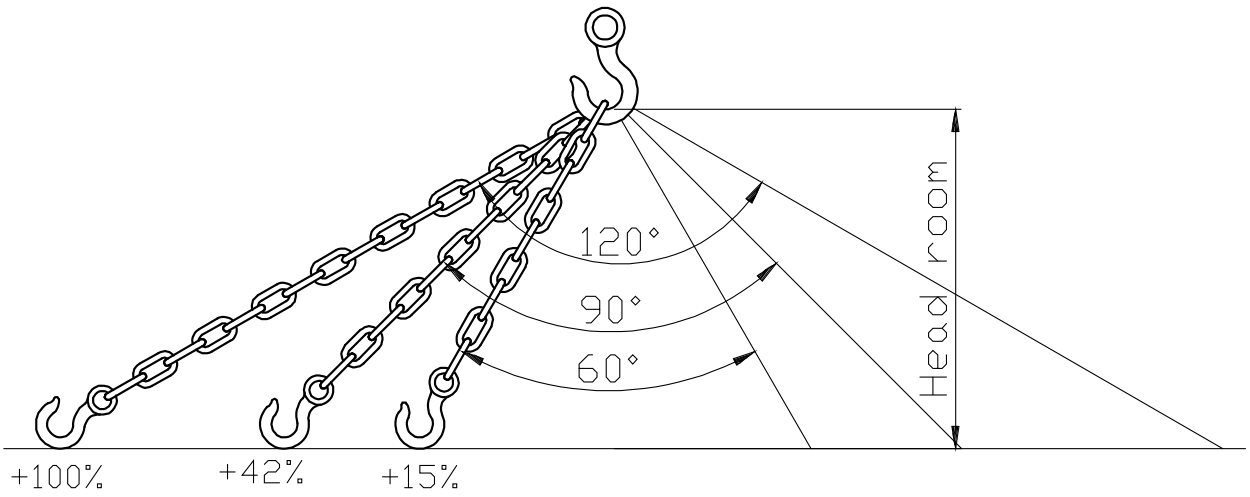


Figure 8.26 determine working clearance and sling length

In relation to the vertical (head room) the length of the sling must be increased by 15% if the included angle is 60°. If the included angle is 90° then the length is increased by 42% in relation to the vertical. If the included angle is 120° then the length is increased by 100% in relation to the vertical.

8.15 Hoist and luffing ropes

We have already mentioned that the hoist and luffing cables are wound around drums to provide the necessary movement. These cables are manufactured from high quality steel, and are excellent for the purpose because of their design.

Figure 8.27 Crane wire cable 6 x 36 construction

Various wire cable construction methods are used by manufacturers. The requirements vary, but are mostly complied with by using a 6 x 36 crane wire cable. (These figures refer to: 6 wire strands layed spirally around a fibre core or steel cable core and 36 wires in each strand wound spirally together.)

The core of a steel wire cable consists mostly of fibre. The important function of the core is that by means of the core the cable is internally lubricated. It also serves as a cushion to absorb shocks.

With the necessary care and safe handling, steel wire cables will give long reliable service. However, a steel cable can be damaged very easily if it is not lubricated regularly. Regular lubrication not only supplements the lubricant in the core, but protects the steel cable against rust and wear.

It is always advisable to report any defect in a hoist or luffing cable whether the damage appears to be of a minor nature or not.

Special attention must be given to the following defects: damage to the cable core, corrosion of the inside of the cable, and whether the cable is flattened or twisted so badly that a certain amount of doubt exists as to its suitability for further use.

Figure 8.28 Damaged wire cable

It is extremely dangerous to use other material such as binding wire, electric cables, etc., for handling loads. Crane drivers must ensure that the slings used are only those which have been made for the purpose.

8.16 Rules for crane operators

The crane operator (driver) must:

- Always keep his eyes on the load which is being handled,
- Read the radius indicator to ensure that the load is within the limits of the crane's capacity,
- Always examine the crane ropes and slings at the start of a shift. Should another sling be required during a shift, this sling must also first be examined,
- Always ensure that the tyre pressure of a mobile crane is correct,

- Always test the safety devices of the crane at the start of a shift to ensure that they are in good working order,
- Always ensure that the crane hook is directly above the load which is to be hoisted, i.e. A load should not be dragged to the centre of the jib before it can be lifted,
- Always ensure that the hand brake of the mobile crane is on when a load is being hoisted or lowered

The crane operator (driver) should not:

- Exceed the maximum load limit for a specific luffing position of the arm;
- Allow the load to hang from the crane without proper control from the crane cabin;
- Swing a load over the heads of other staff who are in the vicinity of the crane;
- Leave the crane unattended while the engine is idling and without the hand brake being applied;
- Drag or push loads when the slewing motion of the crane is employed;
- Switch off the machine or allow it to stall with a load in suspension.

8.17 Hand signals

In order to enable the crane operator to carry out his duties efficiently when communication is difficult because of noise or the distance between the rigger and crane operator, hand signals, and in the case of mine hoists bell signals are used.

To reduce to the absolute minimum the number of accidents, hand signals have been established.

The signals should be thoroughly understood by the signalman and operator. Shown are a few of the basic hand signals (see **Figure 8.29**).

8.18 Overhead crane signals

To warn people working underneath and close to an overhead crane, a horn (hooter) will sound. Different sounds will mean different things:

- One horn blast – move off
- Two horn blasts – move the long travel to the right
- Three horn blasts – move the long travel to the left
- One continuous blast – emergency, either fire, brake failure, or load falling etc.

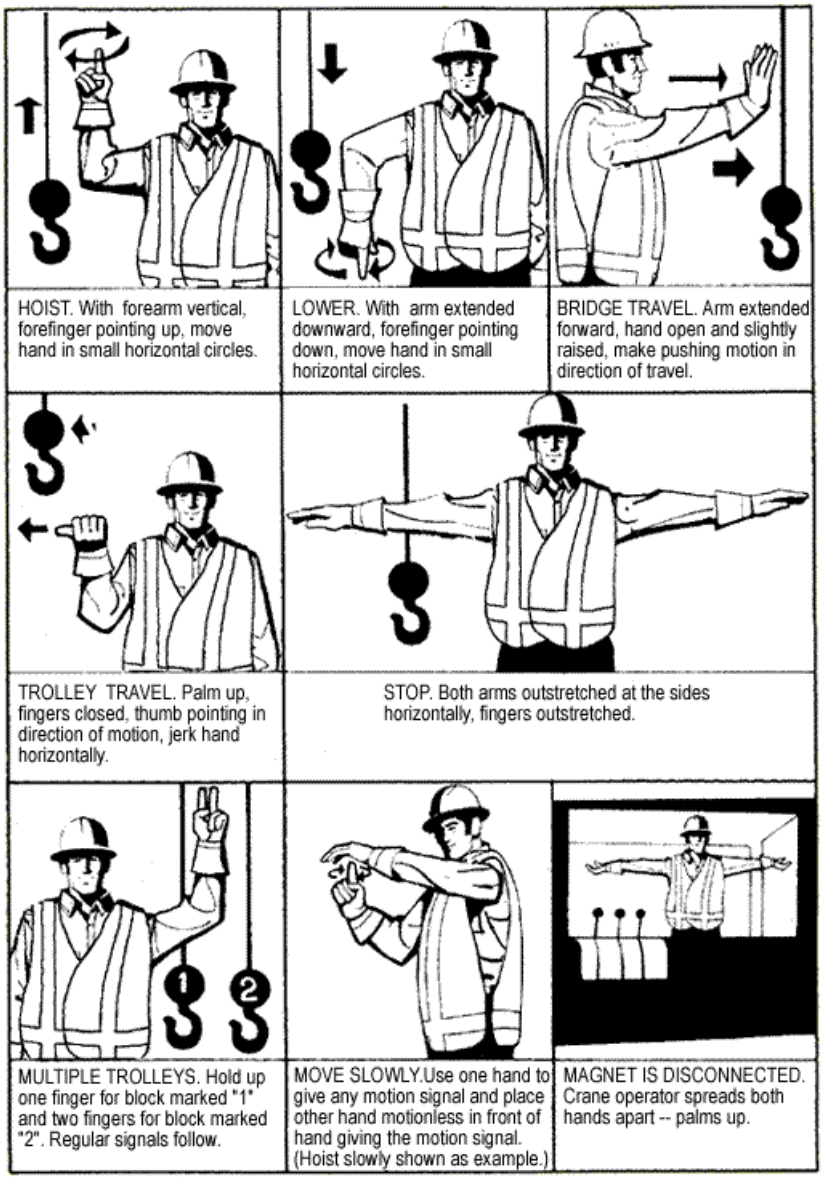


Figure 8.29 Hand signals

Activity 8.1

1. Name four different types of cranes and give one practical example where each type is used.
2. What are the advantages gained by using a mobile crane?
3. Name four precautions to be observed when operating a mobile crane.
4. Name two different types of building cranes in general use and briefly explain how they differ from each other.
5. Two ropes are wound on the hoist drum of most overhead cranes. Give three reasons for this practice.
6. Give short answers to the following questions on hoisting ropes:
   (a) What is meant when referring to the core of the steel wire rope?
   (b) What is its function?
   (c) Why is it important to lubricate steel wire ropes regularly?

7. With the aid of a simple sketch, explain what you understand by referring to a steel wire rope of 6 x 36 construction.
8. (a) Why is it so necessary to make use of hand signals with cranes?
9. (b) Explain with the aid of simple sketches three general hand signals with which you are acquainted.
10. Write a short report (of about 15 lines) on hoist ropes.
11. List THREE different hand signals and make a neat sketch to illustrate your answer.

Activity 8.2

Use the correct technical terms; otherwise use your own words.

1. Name the following cranes AND /OR parts of cranes:
   a) A crane which moves on wheels or tracks
   b) A crane which can only move a short distance on site on rails
   c) A crane which consists of a long vertical part and a rotating horizontal part
   d) A crane which consists of a large vertical part and a lifting part provided at the foot of the device
   e) A crane which has lifting parts which slide out and into each other for the required height.
   f) The vertical fixed part of a cantilever crane
   g) The vertical fixed part of a derrick crane
   h) The pivoted lifting part of a derrick crane
   i) The stabilizing and balancing extensions at the bottom of a crane to give it a bigger base.

2. Sketch ONE or MORE cranes AND clearly indicate the following crane terms.
   a) Tower
   b) Jib
   c) Counter jib
   d) Guy
   e) Mast
   f) Boom
   g) Fly jib
   h) Stay
   i) Outrigger
   j) Latticed parts

3. Use simple sketches to show the characteristics features of the following lifts or cranes:
   a) Material hoist
   b) Scotch derrick
   c) Climbing crane

d) Supported single tower crane
e) Mobile telescopic crane

4. On confined building sites self-climbing tower cranes can be placed in lift shafts.
   Write explanatory notes on the appearance, installation, usage AND removal of such cranes.

Self-Check

I am able to:	**Yes**	**No**
• Name and, using plain line sketches, describe the different types of cranes in use		
• Name and explain important inspection elements on cranes		
• Describe, and using plain line sketches, hand signals used for crane operators in their control operations		
• Explain the basic operating principles of a crab or hoist unit		
• Describe, and using plain line sketches, an automatic brake used on this type of crane		
• Describe what the terms "cross traverse" and "long travel" mean, regarding cranes		
• State the main function, and capacity, of wharf cranes		
• Name and describe the principle, or main parts of wharf cranes		
• Describe slewing and trolley movement of tower cranes (building industry)		
• Name the various parts and rules to be observed regarding mobile cranes		
• Describe travelling of mobile cranes		
If you have answered 'no' to any of the outcomes listed above, then speak to your facilitator for guidance and further development.		

Module 9

Programming of Work

Learning Outcomes
On completion of this module you as a learner should be able to:

- Describe and explain the:
  - Definitions and keywords used in programming
  - Details on programmes and charts
  - Objects in planning
  - Pre-tender planning
  - Contract planning
  - Detailed or Period Planning
  - Preparation of programming
  - Objectives of pre-tender programme
  - Changes in the programme
  - Labour requirements for the contract programme

9.1 Introduction

In this module you will understand the concept of a typical construction programme and the programming of work that is to be carried out on a building project.

Construction programme illustrates and shows the order in which each building stage takes place on a sit and how the various trades dovetail for smooth continuity of progress.

9.2 Definitions and keywords

Table 9.1 refers to keywords and definition used in the programme planning of a building project.

Keywords	Definitions
Planning of a project	To consider everything necessary and all the possibilities is known as the ***planning of a project***. Planning, in general is to collect ideas and all information. It is to look into the available resources, to think through scenarios, and to make budgets, also to set aims and objects which are to be tackled in the future.

Pre-tender Planning	***Pre-tender planning*** is done by all tenderers. It involves all considerations before a tender can be submitted.
Pre-tender period	From the view of the builder, the ***pre-tender period*** is the time before the tender is submitted. It is the period when the builder prepares his offer. In the pre-tender period pre-tender planning takes place.
Contract planning	***Contract planning*** which is the only done by the one successful tenderer who is now called the contractor.
Contract period	The ***contract period*** starts with the signing of the contract and ends when the certificate of completion is issued. It is the period of the construction of the works. Contract planning takes place just after the contract has been awarded. It is usually the very f1rst thing that is done during the contract period.
Contract programme chart	Only the successful tenderer prepares the ***contract programme chart***. It must be more precise than the pre-tender programme chart.
Maintenance period	The ***maintenance period*** is officially called the 'patent defects liability period'. This is the time after handing over when defects have to be made good.
Detail planning	***Detail planning*** is done at any time during the contract period when it becomes necessary to look in depth into certain parts of the works.
Detail programme and phase programme chart	***Detail programmes and phase programmes chart*** give more clarity about issues such as labour teams, plant application or short work periods. An example of a detailed programme is the labour chart.
Programming	***Programming*** is the result from planning. Decisions are taken and drawn into a time-bound roster, the programme (often a-bar chart where the progress can be shown).
Programme chart	A ***programme chart***, in general, is a schedule with tasks to be performed in a set sequence and in a specific time slot.
Pre-tender programme chart	Primarily the ***pre-tender programme chart*** helps to establish the contract period. On a pre-tender programme chart the target date and the completion date should be shown.
Progress chart	The ***progress chart*** is a bar chart and is also called Gantt chart after its inventor. It is a simple graphical method of representing the various operations in a sequence and alotting duration of time to each. It is a prograrnme with enough space to fill in the progress bars underneath the intended programme.
Organisation	To arrange everything necessary and to put the activities into a working order is called ***organisation*** and is mainly done on site by the general foreman. Organising is to get everything ready to execute the programme.

Administration	On the other hand, the ***administration*** is mainly done in the head office and entails the management and arranging of the business arising from the projects.

Table 9.1 Keywords and definitions

9.3 Details on programmes and charts

The following details are normally required and shown on programmes and charts:

- Bars are the thick horizontal lines which represent the duration of a certain operation.
- The programme is shown by the bars drawn for each task as planned to be executed.
- Progress is shown by tile bars that indicate the actual completed work up to the present date.
- The completion date is when the works must be finished as agreed in the contract.
- The target date is the contractor's aim to finish some time before the date of completion. This could earn him a bonus; otherwise it allows him extra time to attend to problems. On a programme the target date should be shown some Time before the completion date.
- The legend is the key to the symbols used for the bars.

9.4 Planning

9.4.1 Objectives in planning

Planning aims to find the best way to execute a project and by taking the available resources into consideration. Provided that proper planning was done in the first place, successful programming is possible. With a good programme, based on proper planning, the progress can be monitored.

Any project, even the smallest alteration job, when not planned well, cannot be as profitable as a thorough planned one. By good planning, the following, points are achieved:

- The project runs smoothly. No or few unforeseen problems occur.
  - The use of plant, labour, materials and equipment is economical.
  - The most suitable way to carry out the various activities is established.
  - The best sequence for the activities is obtained.
  - The dates on which the Sub-contractors and specialists can commence their duties are arranged wel1 in advance. Co-ordination of sub-contractors can be done easily.
- No or only few holdup occur. Completion is on time.
  - Costly holdups through the lack of material etc. are avoided.
  - The progress of the contract is checked in an easy visual manner at any time during the construction period and an early step to rectify the work, which is behind time, is taken.

- No money is wasted. The productivity is high. A profit is possible.
- Quarrels and disputes with the employer are prevented. Good quality of work can be delivered.
- Employees enjoy their work and can ea1-n good wages/salaries.
- The authorities are satisfied.
- Accidents are avoided.

9.4.2 Pre-tender planning

Pre-tender planning starts in the contracts department. Here decisions have to be taken) if and for which project the firm will tender etc.

The rest of the pre-tender planning is mainly done in the estimating department of the building firm.

It involves considerations, such as:

- the time to be allowed for the completion of the works
- the calculation of the tender price
- the methods of performing the major operations.

This form of planning is based on a cost/time ratio. It is not a case of selecting the cheapest or quickest method to include in an estimate, but rather to balance cost against time so that the lowest overall cost, consistent with the shortest time, is achieved.

The estimators must be able to weigh all possibilities) to use information and experience the firm has gained from the past and to identify any snags. Much can be learned from the pre-tender site inspection which is usually arranged for all tenderers by the architect.

A pre-tender programme has to be drawn to be able to visualize and analyse the major tasks with their needs for time, labour, material and plant.

At the same time the firm must do budget planning which is also a part of the pre-tender planning. It is necessary to know how much capital is needed -and available to get the project off the ground (plant and equipment is very expensive and costly).

9.4.3 Contract planning

Contract planning takes place when the- contract has been awarded to the successful tenderer.

- The pre-tender plan is re-examined and a realistic plan of action is drawn up.
- The methods of the primary operations are developed in more detail.
- The site layout plan must be carefully planned

- Plant installations need to be designed and ordered.
- Schedules for delivery dates must be prepared and orders for bulk material deliveries must be negotiated and placed.
- Labour recruitment starts.
- The various sub-contractors should be brought into the planning at this stage so that the work of each one can be phased into the overall plan.
- The contractor must be advised on the facilities which the sub-contractors will require when fulfilling their part of the overall project.

When the contract planning is complete and related to a suitable time scale and written down, the result is known as the contract programme.

9.4.4 Detailed or Period Planning

Detailed, stage or period planning entails the breakdown of the contract programme into stages or areas of work which can then be planned in greater detail. After the planning is done, the results can be written down in a 'blown-up' programme detail.

Examples are:

- the quantities of work to be done each week.
- the constructional details of the project.
- This is necessary so that trade operations may be planned in their correct order. Certain tasks or areas could be highlighted.
- Labour requirement charts for the period of the detailed plan as the day-to-day labour requirements fluctuate; adjustments are made to ensure a reasonable labour utilization.
- The utilization of plant. Plant is very expensive and costly because it is generally only used for a short period or for a specialized task of the project, it is often hired at a rate per hour. For obvious reasons, the plant schedule must be very carefully planned and in very great detail.
- Phases or stages for large projects.

Detailed programmes become a day-to-day guide for the general foreman and for the trades' foremen when issuing instructions and when allocating work to the various teams.

The daily progress of the project may be marked on to the detailed programmes. With good monitoring any delay can be noted and immediate action can be taken.

9.5 Programming

9.5.1 Preparation

The more information available to the planner, the more reliable and accurate will be his forecast and resulting programme. The use of the trades from the bills of quantities to prepare a list of programme elements generally proves very satisfactory.

To enable the planner to make a realistic assessment of the operation, be will call upon the historical information and records obtained from past projects.

1. Subdivide the programme according to practical time sections, days, weeks or months, with the estimated starting and finishing date. This is done in a horizontal direction (the horizontal axis). With a contract programme or detailed programme, space should be left for the bars to be able to indicate the progress later on. This is not necessary when doing a pre-contract programme.

2. List all major activities, trades or operations (on the vertical axis). These should be written down in the correct sequence.

3. Insert the bars according to the planned starting time and completion time for each task. Note that certain tasks can be done simultaneously and thus will their bars overlap. Also, there should be no gaps between operations-otherwise it would mean that for that particular time slot no work is planned at all.

4. The following information must be included:

    - Contract's name and/or contract number
    - Target date
    - Completion dare
    - Holiday periods
    - Sub-contractors

9.5.2 Objectives of the Programme

The pre-tender programme must be drawn up with the following objectives:

- The quickest and most economical way of doing the work based on the available resources.
- The proper phasing of operations with balanced labour force in all trades, to ensure continuous productive work for all staff employed and to reduce unproductive time to a minimum.
- Determination of attendance dates and periods for all sub-contract work. (Attendance is the main contractor's involvement and assistance to the sub-contractors.)
- 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 of a simple and quick method of measuring progress for any particular purpose.

9.5.3 Changes in the programme

A programme should be flexible and easy adjustable. The better a programme is designed the easier it can be changed. With any project in the building industry, change must always be expected.

Reasons for deviations from the programme are:

- Variation orders (wishes of Employer)
- Errors on the drawings or if the information on the drawings and specifications differ. In many cases only provisional documents were available during the planning stage. The finals may give another perspective on the works.
- Extra ordinary weather conditions. Bad weather could hold up the project. When the project is already well progressed rain will only hold up the external work. Internal finishes may carry on. This will require some new planning and co-ordination to accommodate everything and everybody.
- Faults in construction. Work must be redone if it does not pass the quality tests or if the building control officer finds that some Building By-laws or safety rules are not complied with.
- Accidents
- Delayed material deliveries. This is a very common hold up. The general foreman has to do everything in his power to avoid this because usually a whole string of other activities come to a standstill if, for argument sake, bricks do not arrive on time.
- Material as specified is not available. The buyer should ·be aware of such problems. Soon enough he should arrange other specifications with the architect.
- Breakdown of plant
- Strikes, Politics, economy, new laws
- Unreliable sub-contractors. Because this is such a common and big problem many builders try to avoid appointing new unknown sub-contractors, especially for any critical part of the construction.
- Bureaucracy. It happens that work cannot continue because a critical inspection by either the local authorities or the engineer-s has to be done and the relevant inspector does not pitch up. The reason -for that is usually bad communication. All appointments should he confirmed.

Activity 9.1

Use the correct technical terms otherwise use your own words.

1. Your construction firm wishes to tender for a duplex unit-housing scheme. The project should take between 18 to 24 months to complete. Prepare a pre-tender programme for your firm. Assume any details.

2. Give brief explanations for the following:
   a) Planning
   b) Programming
   c) Organising
   d) Administration
   e) Pre-tender period
   f) Contract period
   g) Maintenance period
   h) Target date
   i) Completion date
   j) Gantt chart

3. The contractor has to do severe planning before he can start programming. Distinguish between the following. Also explain how the contractor is involved in these tasks:

   a) Pre-tender planning
   b) Contract planning
   c) Detailed planning

4. It is essential for any project to work according to a well-planned programme to ensure completion within the time specified.
   Explain FIVE (5) reasons why it could become necessary to deviate from the original planned programme.

Self-Check

I am able to:	**Yes**	**No**
Describe and explain the:		
o Definitions and keywords used in programming		
o Details on programmes and charts		
o Objectives in planning		
o Pre-tender planning		
o Contract planning		
o Detailed or Period Planning		
o Preparation of programming		
o Objectives of pre-tender programme		
o Changes in the programme		
o Labour requirements for the contract programme		
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

NOVEMBER 2010

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N4

(**4090034**)

17 November (X-Paper)
09:00 – 12:00

This question paper consists of 5 pages

TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Write neatly and legibly.

QUESTION 1

Different tools and equipment are operated by electricity or by compressed air either tgo rotate the tool or to drive it by percussion in timber workshops.
Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true or 'false next to the question number (1.1-1.10) ANSWER BOOK

1.1 The angle grinder can be used for cutting metal. (1)

1.2 The impact drilling machine is very useful for the bricklayers to drill through walls for pipes. (1)

1.3 Circular saw is used for cutting timber across and along the grain. (1)

1.4 The electric screw driver has an adjustable and sensitive clutch. (1)

1.5 Jig saws are used to cut out patterns. (1)

1.6 Electric power tools must be switched on/off whilst under load. (1)

1.7 Routers are used for cutting out mouldings only when hanging doors. (1)

1.8 Planners are for smoothing and shaping the wood by shaving off layers. (1)

1.9 Sanders cannot be used for cleaning up the wood and smoothing it. (1)

1.10 Pneumatic equipment need a supply of compressed air for their power source. (1)

[10]

QUESTION 2

State the main function of each of the following departments or members of a medium-sized building firm:

2.1 Contracts

2.2 Costing

2.3 Buying

2.4 Personnel management

2.5 Labourers

2.6 Estimating

2.7 Trade foreman

2.8 Artisian

2.9 Accounts

2.10 General Foreman

[10]

QUESTION 3

Describe the following methods by which building firms can obtain opportunities to tender for work:

3.1 Recommendation

3.2 Tender

3.3 Reputation

3.4 Arrangement

3.5 Speculation

[10]

QUESTION 4

4 Explain the method of underpinning by means of enlarged footing and include a sketch of the sequence plan.

[10]

QUESTION 5

5.1 Make a neat, labelled diagram to show a cantilever scaffolding (10)

5.2 State FIVE regulations regarding the erection of scaffolding. (5)

[15]

QUESTION 6

6.1 The main function of the architect is to ensure that ALL queries and disputes are settled in accordance with the term of the agreement.

State FIVE functions of the architect on the construction site. (5)

6.2 State FIVE major duties of the clerk of works. (5)

[10]

QUESTION 7

Make neat, labelled sketches to show the planking and strutting of excavations of the following trenches:

7.1 Hard soil(hard to firm) (5)

7.2 Firm soil(firm to moderate) (5)

7.3 When timbering is not applied to the sides of trenches the excavation could collapse.

7.3.1 State FIVE general causes why trenches may collapse (5)

7.3.2 Briefly explain FIVE safety precautions than timbering to prevent the collapse of the trench excavations. (5)

[20]

QUESTION 8

What are the uses of the following documents?

8.1 The delivery note (1)

8.2 The invoice (1)

8.3 Sketch suitable examples of the above-mentioned TWO documents. (8)

[10]

QUESTION 9

A building site has to be established. What important considerations have to be taken into account during planning in order to incorporate the following structures:

9.1 Sheds and storage areas. (2)

9.2 Site offices (3)

[5]

TOTAL: 100

Marking Guidelines

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NOVEMBER 2010

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N4

(4090034)

This question paper consists of 6 pages

QUESTION 1

1 Tools and equipment

1.1 True (1)

1.2 False (1)

1.3 True (1)

1.4 True (1)

1.5 True (1)

1.6 True (1)

1.7 False (1)

1.8 True (1)

1.9 False (1)

1.10 True (1)

[10]

QUESTION 2

Members of a medium sized building firm.

2.1 Contracts: Handling of contracts documents, negotiation and compiling.

2.2 Costing: The science of investigating, calculating.

2.3 Buying: Ordering of material, obtain quotation for the supply of material and services.

2.4 Personnel Management: Organizes the general clerical duties of the contractors' office for the payment of wages, insurance and all necessary correspondence.

2.5 Labourers: Executes work involving some skill, such as crane and lorry drive.

2.6 Estimating: Costing of projects which are tendered for.

2.7 Trade foremen: In-charge of a trade going team.

2.8 Artisan: Executes work instructed by foreman, and also responsible for laborers.

2.9 Accounts: Prepare and submit accounts to clients and makes payments to suppliers and sub-contractors

2.10 General foreman: Contractors on site representatives, responsible for the day to day running of the site

[10]

QUESTION 3

Method of obtaining business.

3.1 Recommendation: Builders who specialize in alteration and extensions normally find work by this manner. (2)

3.2 Tender: Competing with other builders by submitting a quote. (2)

3.3 Reputation: Firms that rely upon their name for good service and quality built up over a long period of time. (2)

3.4 Arrangement: Standing agreement with chain stores, banks and other nationwide companies to erect new premises. (2)

3.5 Speculation: Risking the firm's own to build houses, flats or even factories for sale to an estimate demand. (2)

[10]

QUESTION 4

Method of underpinning by means of enlarge footing.

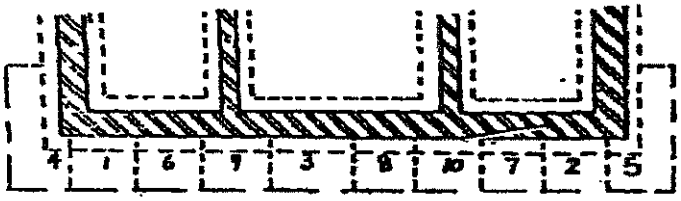
Explanation: Give enough temporary support all around the structure by means of raking shore.

Excavate the soil under the existing foundation in order to place new concrete and this should be done in length of 1m.

Sections should be a metre apart.

Gaps should be tightened up with a stiff mix of mortar.

Give support around all the walls.



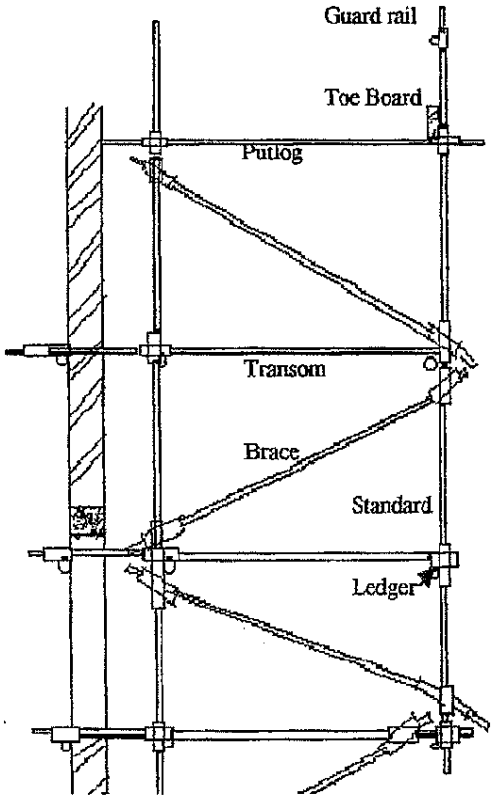
[10]

QUESTION 5

Cantilever Scaffolding.

5.1 Cantilever Scaffolding attached.

(10)



Cantilever Scaffold

5.2 Planks should be overlap and nailed to each other.

Platform should be closely boarded.

Standard must properly rest on a firm base.

All uprights must be plumb.

QUESTION 6

Architects Functions.

6.1 Take full responsibility for the contract under his direction.

Issue monthly or interim certificate.

Issue variation instruction and revised or amended drawings.

To certify the completion of the contract as being his entire satisfaction.

To co-ordinate the work in progress.

To inspect the work site at periodic intervals.

To brief other consultants and to initiate good performance in time. (5)

ANY FIVE

6.2 The representative of the employer on the building site.

To examine all material delivered on site and to approve them.

He informs the Architect on the progress of the work in on a weekly basis.

He keeps record of all deviations from the contract.

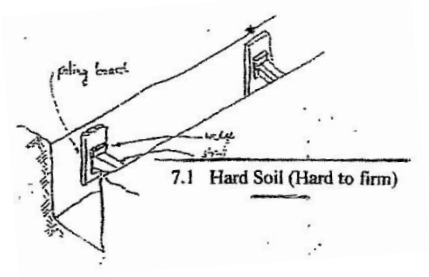
He attends all the site meetings and takes a leading part.

He writes weekly report and hands it over to the Architect. (5)

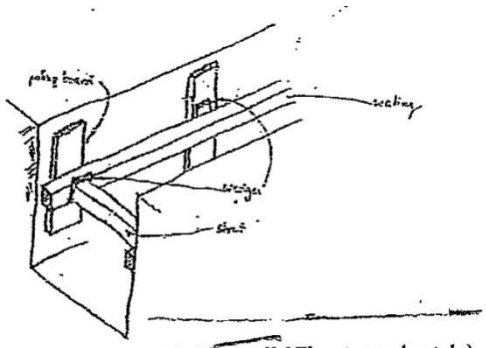
[10]

QUESTION 7: Planking and Strutting of excavations.

7.1 Hard Soil (Hard to firm) sketch see attached. (5)



7.2 Firm Soil (Firm To Moderate) (5)



7.2 Firm soil (Firm to moderately)

7.3 Five general causes of collapse.

Extra Loads.

Creation of new openings.

Striking sides of excavation by heavy loads.

Removal of supports during demolition.

Predicted dangers from the outsides.

Vibration caused by movement of vehicles nearby. (5)

ANY FIVE

7.3.2 Fence in the site.

Leaving the excavation open for a long time.

Use strutting and planking.

Use horizontal side piles.

Excavate by hand, do not use machine, especially for the final touches.

Get rid of ground and rainwater immediately by pumping and baling.

(5)

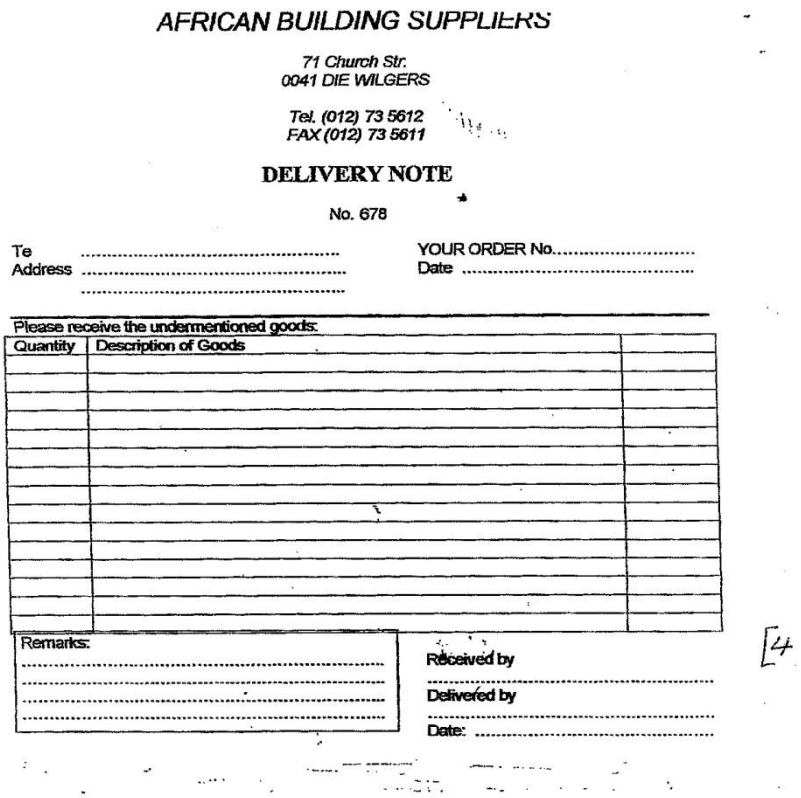
ANY FIVE **[20]**

QUESTION 8: Documents

8.1 The delivery note — A document used to check the goods against ordering documents which both driver and the receiver sign. (1)

8.2 The invoice: — A document that requests for payment and which the rates and total prices are clearly shown. (1)

8.3 — Two sketches of the above attached. (8)



AFRICAN BUILDING SUPPLIERS

71 Church Str.
0041 DIE WILGERS

Tel. (012) 73 5612
FAX (012) 73 5611

DELIVERY NOTE

No. 678

Te .....
Address .....
.....

YOUR ORDER No.....
Date .....

Please receive the undermentioned goods:

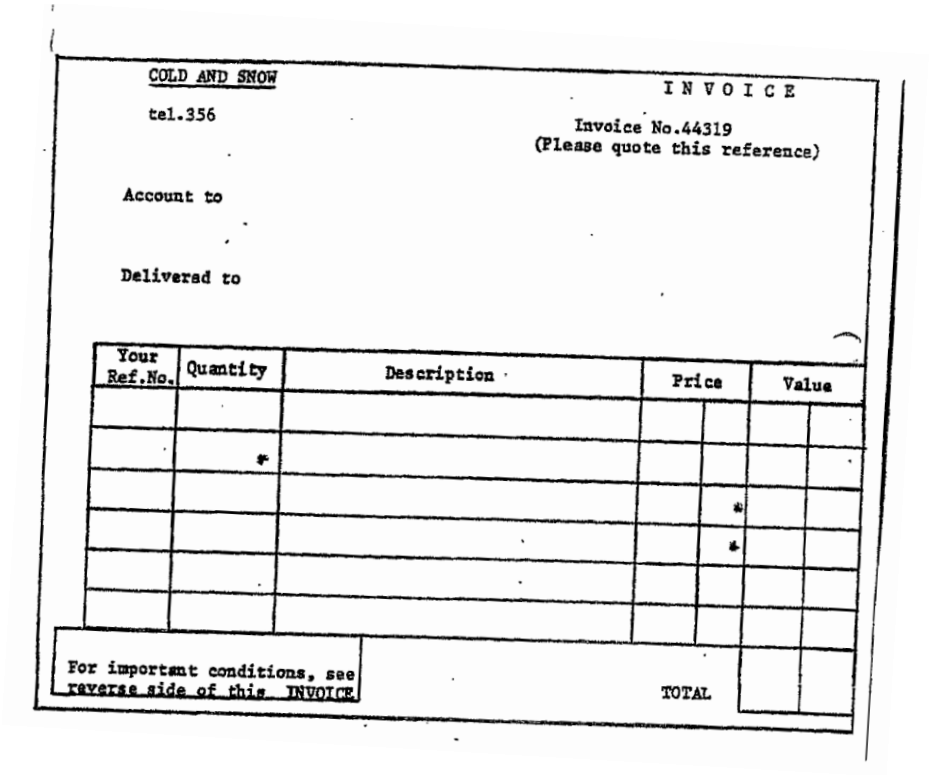
Quantity	Description of Goods	

Remarks:
.....
.....
.....
.....

Received by .....
Delivered by .....
Date: .....

[4

[10]



COLD AND SNOW

tel.356

INVOICE

Invoice No.44319
(Please quote this reference)

Account to

Deliverad to

Your Ref.No.	Quantity	Description	Price		Value	

For important conditions, see reverse side of this INVOICE

TOTAL

QUESTION 9: Planning of storage on site

9.1 Sheds and storage areas: Material must be stored according to various special needs.

Place them near the gate to ease deliveries

Incorporate accommodation for the storekeeper.

(2)

ANY TWO

9.2 Site Offices: Place storage areas as near as possible to the site offices to ensure better monitoring.

Save space for the movement.

Consider the sizes and amounts of the expected materials

(3)

[5]

TOTAL: 100

Past Examination Papers

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NOVEMBER 2012

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N4

(**4090034**)

16 November (X-Paper)
09:00 – 12:00

This question paper consists of 5 pages

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers correctly 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(1.1-1.10) in the ANSWER BOOK.

1.1 The contractor must insist on receiving receipts.

1.2 A receipt is a proof issued by the supplier that payments must not be paid in advance.

1.3 Receipts must never be compared with subsequent invoices or any other contract documents.

1.4 It is good practice to request regular statements list on most recent invoiced items and payments

1.5 The Crane with a lever which slides out its maximum length is called...

1.6 A copy of the invoice should not accompany the payment.

1.7 Every invoice must be paid twice and double its price to avoid arrears.

1.8 Invoices must be kept for any queries during the final account stage.

1.9 Invoices are requests for payments

1.10 Invoices must be checked against the orders from the buying departments.

[10]

QUESTION 2

Complete the following sentences by using the words given in the list below. Write only the word(s) next to the question number(2.1-2.10) in the ANSWER BOOK.
Buyer; general foreman; artisan; quantity surveyor; personnel department; building surveyor; costing clerk; contractor; estimator; valuation.

2.1 After the tender is accepted and the necessary contract documents signed, the builder will be call a....

2.2 On site the... is in charge of all construction.

2.3 Trades foremen are in charge of particular groups of...

2.4 For the builder works, the ... must place all orders in good time for the material and plant

2.5 The ... has to see to it that sufficient labour and controlling staff is employed

2.6 At frequent intervals the ... analyses actual costs of all work done.

2.7 The... of the building firm uses these actual rates when tendering again for a new contract.

2.8 The architect has to certify the ... before payment can be made.

2.9 After a lapse of time the... will claim an interim payment from the client.

2.10 The ... who is an advisor of the employer, has to check the claim by valuating the work done to date. **[10]**

QUESTION 3

State the differences between the following building firms by describing each of them:

3.1 Small firms. (4)

3.2 Medium firms. (4)

3.3 Large firms. (4)
[12]

QUESTION 4

Make clear, labeled sketches to show how the following shores differ when supporting weak structures:

4.1 Single-flying shores. (7)

4.2 Double-flying shores. (7)
[14]

QUESTION 5

The main function of the clerk of works is to ensure that the quality of workmanship is of the highest standard.
State SEVEN other functions which the clerk of works is respnsible for on site.
[12]

QUESTION 6

6.1 Make a labeled diagram to show a cantilever scaffolding. (12)

6.2 State SEVEN regulations regarding the erection of a scaffold. (7)

[19]

QUESTION 7

When timbering is not applied to the sides of trenches, the excavation could collapse.

7.1 State FIVE general causes why trenches collapse. (5)

7.2 Explain each of the following terms as used in timbering for excavations:

7.2.1. Poling board. (1)

7.2.2 Waling (1)

7.2.3 Planking (1)

7.2.4 Strutting (1)

7.2.5 Struts (1)

[10]

QUESTION 8

Briefly explain each of the following methods by which building firms can obtain business:

8.1 Rotation . (2)

8.2 Negotiated tender. (2)

8.3 Request. (2)

8.4 Arrangement (2)

8.5 Recommendation. (2)

8.6 Speculation. (2)

[12]

QUESTION 9

A pre-tender programs must be drawn up with objectives. State any SIX objectives of pre-tender programs.

[6]

TOTAL: 100

Marking Guidelines

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NOVEMBER 2012

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N4

(4090034)

This question paper consists of 6 pages

QUESTION 1

1.1 True (1)

1.2 False (1)

1.3 False (1)

1.4 True (1)

1.5 True (1)

1.6 False (1)

1.7 False (1)

1.8 True (1)

1.9 True (1)

1.10 False (1)

[10]

QUESTION 2

2.1 Contractor.

2.2 General foreman.

2.3 Artisan/ apprentices, skilled or unskilled.

2.4 Buyer.

2.5 Personnel department.

2.6 Costing clerk.

2.7 Estimator.

2.8 Valuation.

2.9 Building surveyor

2.10 Quantity surveyor.

[10]

QUESTION 3

3.1
- There is little specialization of functions.
- Consist of the builder tradesman & labourers.
- Builder concerned with the planning, supervisor and all work executed by the firm.
- Communication is direct to the contractor and the employer.

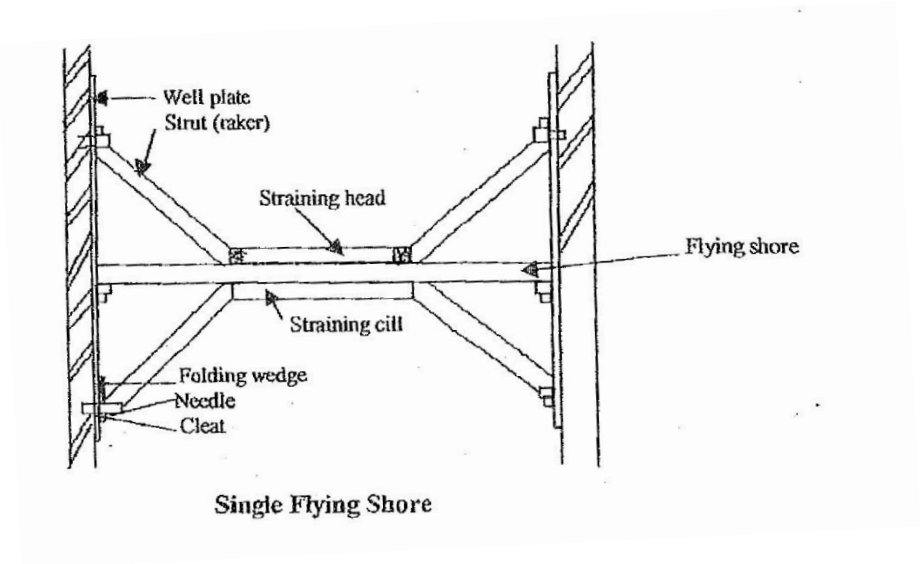
3.2
- Owner concentrates on management.
- Delegate foreman to a foreman.
- Communication is between the foreman and the architect.
- No supervisor is appointed.

3.3
- Builder can no longer be concerned with the detailed supervision.
- The firm takes large and many architects.
- The main formation/concern will be the general development of the firm that involves various departments.

[10]

QUESTION 4

4.1

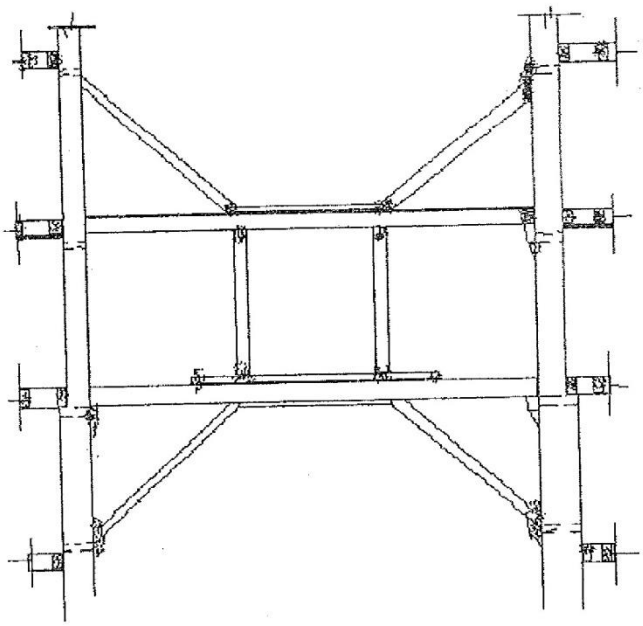


Single Flying Shore

(7)

QUESTION 4

4.2



Double Flying Shore

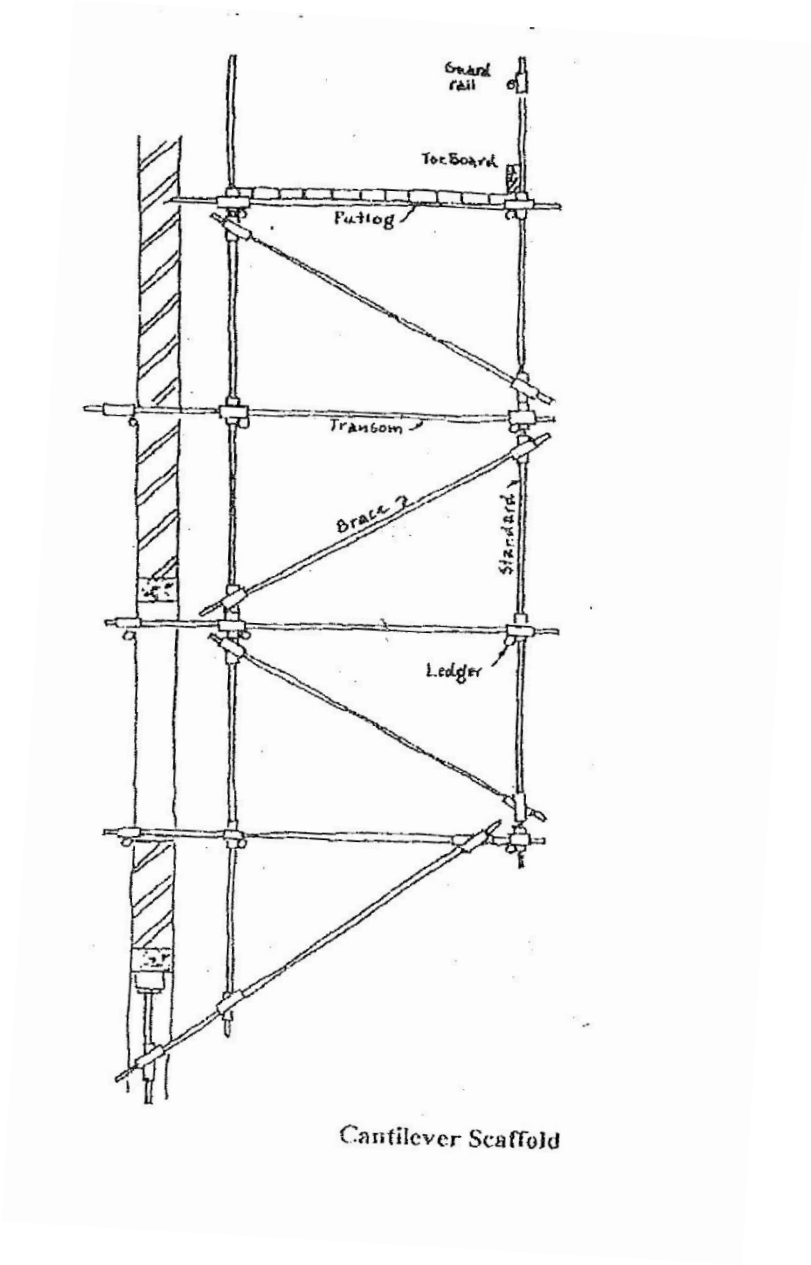
(7)
[14]

QUESTION 5

- To represent the employer on the building site.
- To ensure the performance of the terms of the contract.
- He attends all site meetings and takes a leading part.
- He writes weekly reports and submit them to the architect.
- He keeps records of all deviations from the contract.
- To advice had office of any labour requirements.
- To examine all materials delivered on site and to approve them.

[7]

QUESTION 6



Cantilever Scaffold

(12)

6.2

- Wires and rope should not be used.
- All uprights must be plumb.
- Standards must rest on a firm base.
- Putlogs must be properly rested onto the brick work.
- The minimum thickness of the timber boards should be 38mm.
- A qualified artisan should erect the scaffold.
- The gaps between the boards must be a few millimetres.

(7)

QUESTION 7

7.1

- Vibrations form compaction plant.
- When materials are too close to the sides.
- When excavation plant and equipment are too close to the edge.
- Variations in the nature of the soil, such as pockets of sand.
- When soil is unable to support its own eight. (5)

7.2

7.2.1 Poling board:

- the planks that are vertically place across the face of the sides of the trenches. (1)

7.2.2 Wailing:

- is a plank that is peaked across the poling boards parallel to the trench before the struts are place in position. (1)
-

7.2.3 Planking:

- the transfer of load from the shores equally into the existing floor or the ground when shores are place onto sole plates. (1)

7.2.4 Strutting:

- vertical support wedged between the wailings at the ends of the struts (1)

7.2.5 Struts:

- horizontal numbers at a right angle between the poling boards an inclined support member. (1)

[10]

QUESTION 8

8.1 Rotation:
- to give more builders a chance to tender and better chance to win a tender.
- to limit the number of tenders. (2)

8.2 Negotiated tender:
- to come to an agreement with a builder who has worked for you before.
- invite the other builder to discuss the matter of quotes. (2)

8.3 Request:
- when the firm requests the architect to be included in the list of tenders. (2)

8.4 Arrangement:
- standing agreement with chain stores.
- agreement with an organisation that sells design council houses. (2)

8.5 Recommendation:
- specialises in alterations and extensions.
- satisfied customer by acquaintance (2)

8.6 Recommendation:
- risking the firm's own money to build houses and flats for sale to an estimated demand.
- buying more stands to build houses and more property to be sold. (2)

[10]

QUESTION 9

- The amount and capacity of plant required and the period of use site.
- Quick method measuring progress for the builder's information, architects certificate.
- Quick method of valuation of work for accounting purposes.
- Determination of attendance dates and periods for all sub-contract work.
- Balanced labour gangs in all trades.
- To ensure continuous productive work for all staff employed and reduce unproductive time to a minimum. (6)

TOTAL: 100

Past Examination Papers

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

APRIL 2013

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N4

(**4090034**)

16 November (X-Paper)
09:00 – 12:00

This question paper consists of 5 pages

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Write neatly and legibly.

QUESTION 1

Complete the following sentences by filling in the missing word(s). Write only the word(s) next to the question number(1.1-1.10) in the ANSWER BOOK.

1.1 After the tender is accepted and the necessary contract documents are signed, the builder will be referred to as the...

1.2 The... works for the builder and places all orders in good time for the material and plant.

1.3 The... of the building firm uses actual rates when tendering again fro new contracts.

1.4 At frequent intervals the... analyses actual costs of all the work done.

1.5 The... has to see to it that sufficient labour and controlling staff is employed.

1.6 On site the... is in charge of all construction Under him(1.7)... is in charge of a particular group of (1.8)... and (1.9)...labourers.

1.10 At frequent intervals the... analyses actual costs of work done.

[10]

QUESTION 2

The general foreman and the trade's foreman who may well love the outdoors, face completely different challenges than their counterpart, the foreman who supervises a workshop.

Discuss these problems of the site in comparison with those of the workshop.

QUESTION 3

Make us of clear, labelled sketches to show how the following supports weak structures:

3.1 Single flying shore. (5)

3.2 Double flying shore. (5)

QUESTION 4

4.1 When planning the location of the storage areas and sheds, you should keep some of the facts in mind. State FIVE points which must be considered when planning the location of the storage areas and sheds. (5)

4.2 When timbering is not applied to the sides of trenches the excavation could collapse. (5)

State FIVE causes why trenches could collapse.

4.3 As a general foreman, how would you solve the following problems regarding the delivery of building materials?

4.3.1 To cut down on wastage.

4.3.2 To prevent theft.

QUESTION 5

Production depends on the right quantity of components being delivered on time. It is essential to organise prompt receipt by follow-up and processing orders.

Discuss the following:

5.1 Follow-up operations. (6)

5.2 Processing orders. (6)
[12]

QUESTION 6

Make neat, labelled sketches to show the planking and strutting of excavations for the following trenches:

6.1 Hard soil. (5)

6.2 Firm soil. (5)
[10]

QUESTION 7

7.1 The lad on an existing building is to be increased and therefore the building has to be underpinned. (5)

Sketch and briefly explain the method of underpinning by means of jacked precast piles

7.2 Define underpinning and expalin why it is applied to foundations. (5)
[10]

QUESTION 8

8.1 You are working in a construction firm which wishes to tender for a duplex unit-RDP housing scheme. The project should take between 15-22 months to complete.

Prepare a pre-tender program for your firm. Assume any details. (10)

8.2 Write explanatory notes on the importance and functionality of the following contract documents: (5)

8.2.1 The working drawings. (4)

8.2.2 The bills of quantities. (4)

[18]

TOTAL: 100

Marking Guidelines

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

4 APRIL 2013

NATIONAL CERTIFICATE

BUILDING ADMINISTRATION N4

(4090034)

This question paper consists of 10 pages

QUESTION 1

1.1 Contractor.

1.2 Buyer.

1.3 Estimator.

1.4 Costing clerk.

1.5 Personnel department.

1.6 General foreman.

1.7 Trades foreman.

1.8 Artisan/Apprentices.

1.9 Unskilled.

1.10 Costing clerk

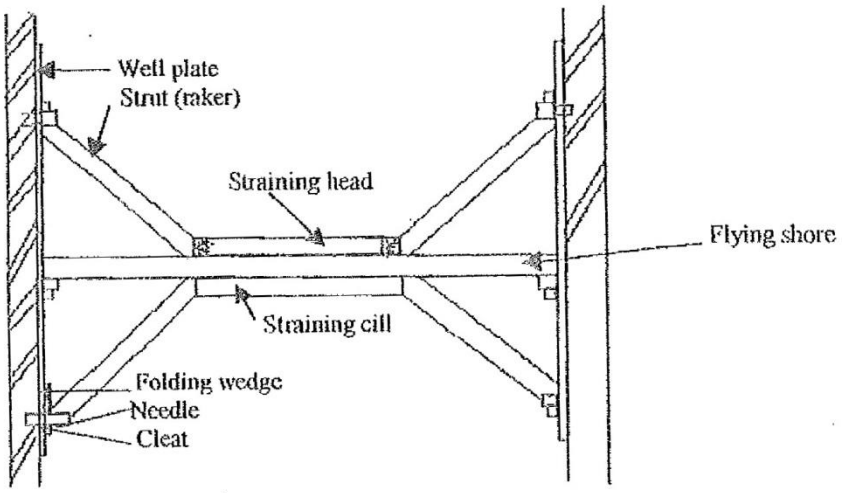
[10]

QUESTION 2

CONSTRUCTION SITE	**WORKSHOP**
The workers and the supervisors are exposed to the elements, there is no shadow, no heater, no roof.	Work is done under shelter and materials and products will not be damaged by rain.
Supervision is difficult, foreman has to patrol large area.	Supervision is easy.
Strength of material is a problem.	Permanent storage areas can be allocated.
Construction work is dangerous at times.	Dangerous machines are sheltered from other machines.
During bad weather valuable construction time will be lost.	If cold, heaters can be turned on.
	[10]

QUESTION 3

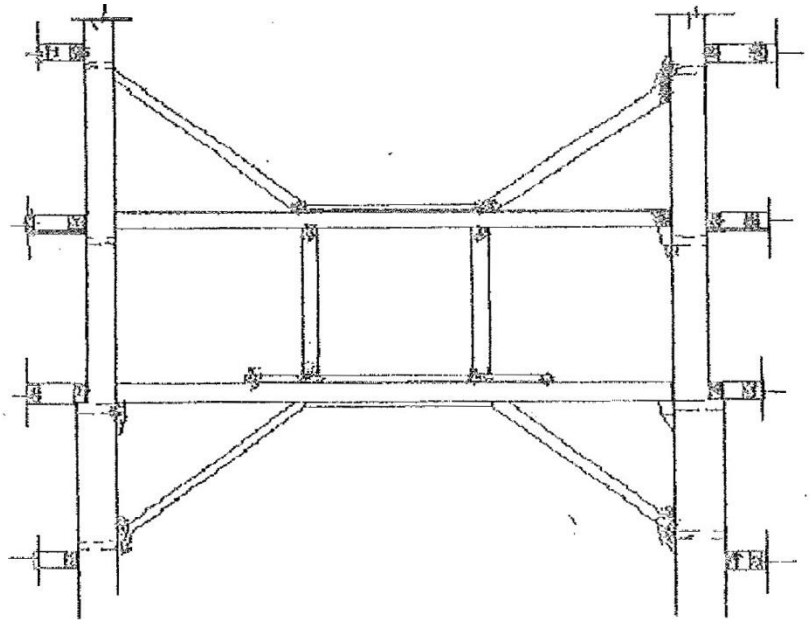
3.1



Single Flying Shore

(5)

3.2



Double Flying Shore

(5)

[10]

QUESTION 4

4.1
- Material must be stored according to various special needs.
- Material must be sheltered against damage, wastage and theft.
- Storage areas must be near as possible to the site offices to ensure better monitoring.
- Incorporate accommodation for the storekeeper.
- Walkways should be covered and strong enough to use its decks for storage.

4.2
- Extra loads.
- Creation of new opening.
- Degeneration of the structure.
- Predicted dangers from the outside
- Removal of supports during demolition

4.3 4.3.1
- By avoiding overstocking.
- By supervising the offloading and handling.
- By doing the proper standard quality tests when stocks arrive.
- By not accepting damaged material from the supplier.
- By ordering correct material and right sizes.
- Know your permanent staff.
- By having a trustworthy storekeeper.

(Any 5 x 1) (5)

4.3.2
- By increasing the price of the work.
- Site must be securely fenced.
- Material must not be left in sight of passer-bys.
- All sheds must be properly locked.
- Be aware of temptation.

(5)
[20]

QUESTION 5

5.1
- The buying department must make sure that the delivery will really take place as planned.
- The material should be ordered early in order to sort out problems in time.
- An order must be confirmed before delivery.
- Everything received must be confirmed before delivery.
- Telephone orders must be confirmed in writing.
- Late and overdue deliveries need special attention

[20]

5.2

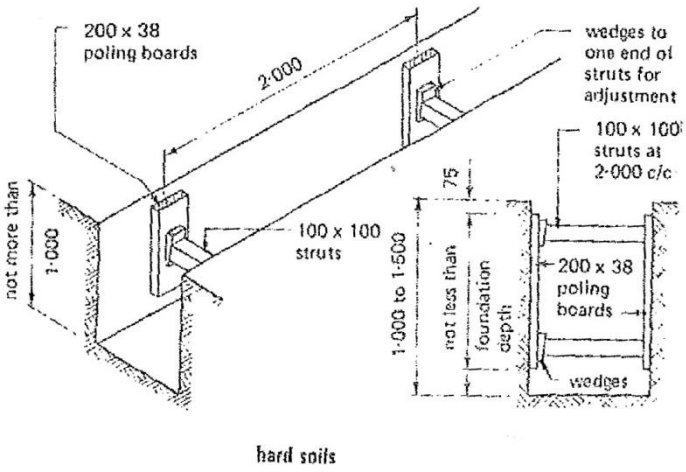
- Practical quantities should be ordered.
- Progress on site must be take into consideration.
- Enough material must be ordered to keep the work flowing.
- Forward copies of detailed program of the schedules to the suppliers and stay in touch with them.
- Know exactly when to expect deliveries.
- Keep in touch with the storekeeper.
- You should not blame the buying department.

(Any 6 x 1) (6)

[12]

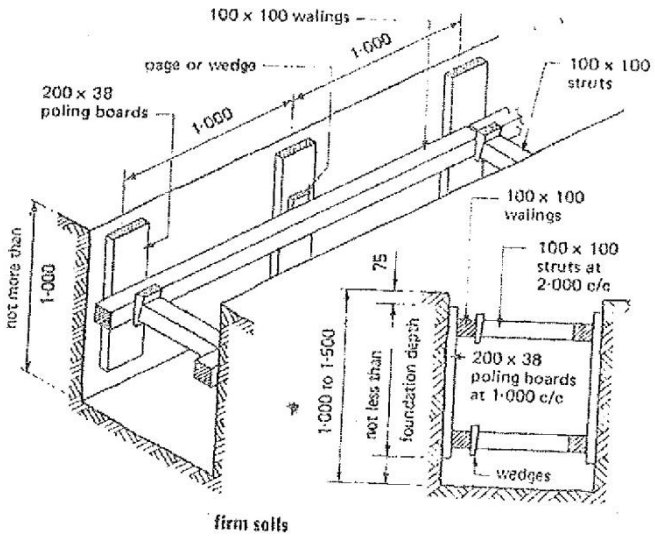
QUESTION 6

6.1



(5)

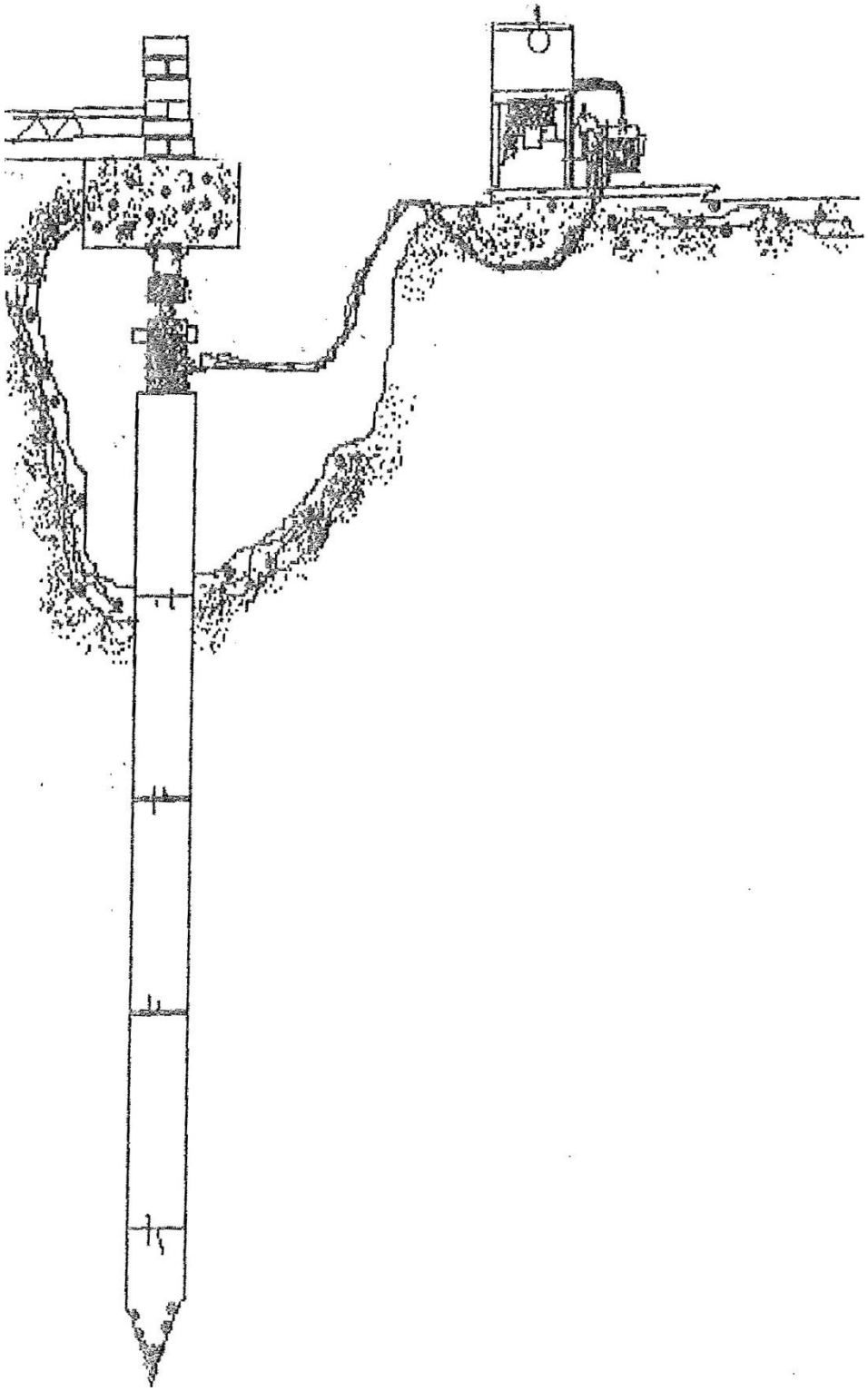
6.1



(5)

[10]

QUESTION 7



Explanation:

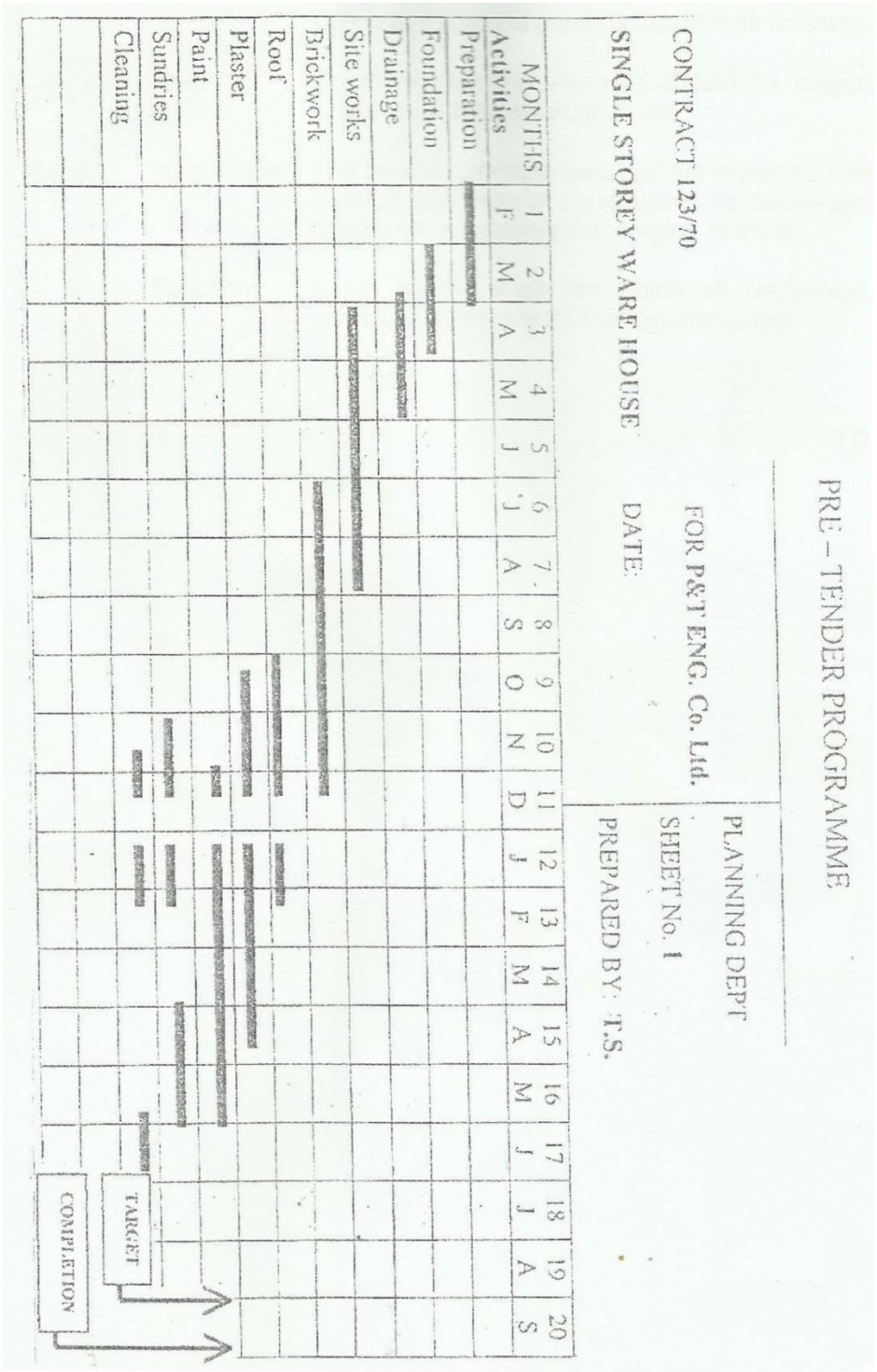
7.1
- A hole is excavated below the existing footing of the building.
- Place the first section of the pile on the ground.
- Force the sections downwards by means of hydraulic jack.
- Remove the jack and repeat the process with the second subsequent section.
- The pile sections then interlock by means of a metal rod between them. (5)

7.2 Underpinning is the provision of permanent support beneath existing structures. (2)

Application: It is applied to a foundation to provide strength where settlement has occurred and where new loads have to be imposed. (3)

[10]

QUESTION 8


PRE – TENDER PROGRAMME
PLANNING DEPT
FOR P&T ENG. Co. Ltd.
SHEET No. 1
CONTRACT 123/70
SINGLE STOREY WARE HOUSE
DATE:
PREPARED BY: T.S.
MONTHS
Activities
1 F
2 M
3 A
4 M
5 J
6 J
7 A
8 S
9 O
10 N
11 D
12 J
13 F
14 M
15 A
16 M
17 J
18 J
19 A
20 S
Preparation
Foundation
Drainage
Site works
Brickwork
Roof
Plaster
Paint
Sundries
Cleaning
TARGET
COMPLETION

8.2 8.2.1 Importance: It consist of plans, sections and elevations of the building and sufficient large-scale detail drawing to describe the whole construction and its finishing.

Function :To show how the structure should be constructed and show storm-water drain etc. (4)

8.2

8.2.2 Importance: The bills of quantities sets out the expected measure of each operation of construction as calculated from the drawings, classified according to trade.

Function: Serve as the basis on which all adjustment and variation of the works shall be measured. (4)

[18]

TOTAL:100

N4 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.

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