N4

Building Administration

Lecturer Guide

Sparrow Consulting

in collaboration with Marc Pellencin

Additional resource material for this title includes:

- **PowerPoint presentation**
- **Interactive tests**
- **Past exam papers**
- **Electronic Lecturer Guide**

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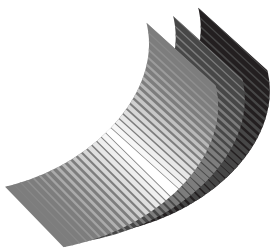

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Contents

Lecturer Guidance

1. General aims

To develop a student's ability to manage construction sites and adhere to safety standards and procedures.

2. Specific aims

The student should obtain a thorough background of administering a construction site.

3. Prerequisites

The student must meet at least one of the following requirements:

3.1 Have a national N3 certificate with civil engineering subjects.

3.2 Passed Grade 12 with civil technology and engineering graphics design.

3.3 Completed NCV Level 4 in a civil engineering programme.

4. Duration

Full-time: 7.5 hours per week. This instructional offering may also be offered part-time.

5. Evaluation

5.1 Evaluation is conducted continuously by means of two formal tests at college level. The learner must obtain a minimum ICASS mark of at least 40% in order to qualify to write the final examination and a mark will be calculated together in a ratio of 40:60 to derive the promotion mark. The learner must obtain at least 40% on the final examination.

The promotion mark will be calculated as follows:

Promotion mark = **40%** of (ICASS mark) + **60%** of (Exam mark)

5.2 The examination in Building Administration N4 (Engineering studies – Report 191) will be conducted as follows:
Modules 1–8 **MARKS:** 100
DURATION: 3 HOURS
CLOSED BOOK: drawing instruments may be used

5.3 **Weighting**:
The following weights are consequently awarded to each category:

Knowledge and Understanding	Applying	Analysing/Syntheses and Evaluating
30–40	30–40	20–25

6. Learning content

THEORETICAL BACKGROUND
It is essential that this subject should be illustrated and evaluated within the context of practical case studies.

TECHNICAL BACKGROUND
It is essential that this subject should be illustrated and evaluated within the context of technical skills and simulation of a practical environment.

7. Mark allocation and weighted value of modules

MODULES	WEIGHTING
1. Professional consultants	10
2. Building firms	10
3. Site preparation	15
4. Planning and programming	10
5. Building materials	15
6. Construction equipment	20
7. Foundations	10
8. Organisations in the construction industry	10
Total	**100**

8. Work schedule

Week	Topic	Content	Hours
1	**Module 1** Professional consultants	1.1 Duties and responsibilities	10 hours
2	**Module 2** Building firms	2.1 Types of building firms 2.2 Departments of a building firm 2.3 Acquiring business	10 hours
3–4	**Module 3** Site preparation	3.1 Organisational structures on a building site 3.2 Site preparation 3.3 Site layout 3.4 Regulations	15 hours
4–5	**Module 4** Planning and programming	4.1 Planning 4.2 Gantt charts	10 hours
5–6	**Module 5** Building materials	5.1 Ordering 5.2 Documentation 5.3 Wastage	15 hours
7–8	**Module 6** Construction equipment	6.1 Scaffolding 6.2 Equipment and machinery	20 hours
9	**Module 7** Foundations	7.1 Functions of a foundation 7.2 Types of foundations 7.3 Soil conditions	10 hours
10	**Module 8** Organisations in the construction industry	8.1 Organisations	10 hours
TOTAL			**100 hours**

9. Lesson plan template

Subject and level	N4 Building Administration	**Campus**	
Prescribed textbook (Title and author)	*N4 Building Administration* by Sparrow Consulting	**Lecturer**	

WEEK 1

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

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WEEK 2

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

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WEEK 3

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

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WEEK 4

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

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WEEK 5

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

Subject and level	N4 Building Administration	**Campus**	
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WEEK 6

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

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WEEK 7

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

Subject and level	N4 Building Administration	**Campus**	
Prescribed textbook (Title and author)	*N4 Building Administration* by Sparrow Consulting	**Lecturer**	

WEEK 8

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

Subject and level	N4 Building Administration	**Campus**	
Prescribed textbook (Title and author)	*N4 Building Administration* by Sparrow Consulting	**Lecturer**	

WEEK 9

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

Subject and level	N4 Building Administration	Campus	
Prescribed textbook (Title and author)	*N4 Building Administration* by Sparrow Consulting	Lecturer	

WEEK 10

Content/outcomes to be covered this week	List of examples to be done in class by the lecturer to explain the outcome/ concept	Facilitation method (Please tick)		Teaching resources/ aids (Please tick)		Student activity (exercise in textbook/additional supporting tasks) to be done this week
		Lecture		White board/OHP		
		Group work		Models		
		Demonstration		Handouts		
		Simulation		Multimedia		
		Introduction to lessons				
		Recapping/reinforcement				

This page may be photocopied.

1 *Professional consultants*

By the end of this module, students should be able to:

- explain the roles and responsibilities of the following professionals in the construction industry:
  - client/owner/employer
  - architect
  - site foreman
  - quantity surveyor
  - structural engineer
  - mechanical engineer
  - electrical engineer
  - land/building inspector
  - clerk of works.

When you look around, you will see that you are surrounded by infrastructures such as roads, buildings, bridges and tunnels, to name a few examples. Infrastructure is the product of one of the largest industries in the world: the construction industry. The construction industry can be divided into three main categories: general construction, speciality trade construction and civil engineering construction. In these categories, various professionals are responsible for a specific segment of the construction project. In this module, students learnt about the various roles and responsibilities of the client of such a project as well as the following professionals:

- Architect
- Quantity surveyor
- Site foreman
- Structural engineer
- Mechanical engineer
- Electrical engineer
- Land surveyor
- Building inspector
- Clerk of works.

Group activity 1

SB page 11

Resources needed:

- A2/A3 poster board per group
- Coloured Koki pens
- Glue
- Ruler
- Pencil

Instructions

- Divide the class into groups of TWO or FOUR
- Let each group choose one professional per group member
- Each group member must do research on their respective professional in order for them answer the questions asked in the Student Book
- Each group member must present their information and poster to their classmates

Take note

Although it is important how the poster looks and how the student does the presentation, the information which they have gathered and the way in which the students worked together as a team is of more importance.
You can use the following rubric to mark each group.

Criteria	Excellent	Very good	Good	Below average	No effort put into task
	5	4	3	2	1
Poster					
• Coverage of the topic					
• Organisation					
• Layout and design					
• Graphics, text size, readability					
• Attractiveness					

Presentation					
• Use of time					
• Voice (i.e., volume, tone, and clarity)					
• Eye contact					
• Facts and detail					
Teamwork					
The design of the poster shows that the students worked together as a team and not as individuals. • It looks the same • It follows the same logic					

Exercise 1.1

SB page 12

1. 1.1 C
   1.2 D
   1.3 A
   1.4 E
   1.5 B (5 × 1)

2. Heating, ventilation and air conditioning (1)

3. • Private client: domestic client requiring the construction of a house or alterations to an existing house
   • Commercial client: a business or company that requires the construction of a building or alterations to a building to satisfy its business needs
   • Government client: a government department that requires public infrastructure such as roads, buildings, bridges and tunnels (3 × 3)

4. The architect is the person responsible for interpreting the client's idea and producing a design✓ that takes into account the costs,✓ building laws✓ and regulations,✓ while providing some artistic flair.✓ (5)

5. 5.1 True
   5.2 False. The quantity surveyor prepares the final detailed estimate of the costs (the bill of quantities)
   5.3 False. The structural engineer calculates loads and stresses relevant to buildings

5.4 False. The mechanical engineer checks the dimensions of the incoming materials to ensure that the dimensions are within the permissible limits

5.5 False. The electrical engineer tests all electrical systems (5 × 2)

6. Any four of the following:
   - Approving building plans
   - Checking the structural quality and the general safety of buildings
   - Checking that all electrical, plumbing and HVAC systems are within regulation
   - Issuing violation notices and stop-work orders if a building or structure is not compliant
   - Performing a final thorough inspection after a project has been completed and providing written and oral feedback on the findings

(4 × 1)

7. Clerk of works (1)

Total: 35 marks

Summative assessment SB page 18

Various options are given as possible answers to the following questions. Choose the answer and write the letter (A–D) next to the question number (1.1–1.10) in your workbook.

1.1 B – Government client
1.2 C – Contractor
1.3 D – All of the above
1.4 A – Mechanical engineers
1.5 B – Client
1.6 C – Boundary surveyor
1.7 D – Clerk of works
1.8 A – Building inspector
1.9 C – Construction surveyor
1.10 A – Structural engineer

(10 × 1)

2.1 Any five of the following:

- Designing, testing and installing electrical systems for commercial, residential and industrial construction projects
- Carrying out feasibility studies for new technical developments
- Drawing up project plans and producing models, prototypes and circuit diagrams for high-and low-voltage electrical equipment
- Preparing cost estimates for materials and labour before construction begins
- Managing the construction schedules
- Managing and overseeing teams of electrical contractors
- Interacting with the construction teams to identify and resolve development issues
- Ensuring that the electrical installation and operations conform to standards and customer requirements
- Testing all electrical systems
- Resolving electrical issues that may arise on site
- Revising electrical plans due to changes in the building's design

(5 × 1)

2.2 The data gathered during the initial surveying process are used to monitor changes in the land condition✓ during the construction process and provide information crucial to the construction planning phase,✓ for example:

(Any three of the following)

- Whether the land is prone to flooding
- The characteristics of the land that might affect the structure to be built, e.g. the type of soil or weather earthquakes are a common occurrence
- What excavation or other manipulation is needed to prepare the land
- Which utilities and piping networks are already available and what is needed

(5)

2.3 Building inspectors are appointed by the city council and conduct periodic site visits to ensure that contractors comply with regulations and plan specifications.
Clerks of works are appointed by the client or the architect and conduct regular site visits to ensure that the client's interests are represented. (2 × 2)

2.4 Any six of the following:

- Implementing and monitoring all on-site mechanical-related operations as per the approved drawings and safety rules
- Designing all mechanical components, such as the **HVAC** and plumbing systems
- Interpreting the construction drawings, contract documents and applicable standards or specifications before any work is done
- Ensuring that all work done is in accordance with the approved construction drawings, contract documents and project specifications as well as all applicable health, safety, sanitary and environmental standards
- Ensuring that the equipment is erected, precommissioned, tested and commissioned in accordance with the agreed contracts
- Supervising the installation of machines and equipment on site
- Going on regular site walks to ensure that the construction project is being built properly
- Checking the dimensions of the incoming materials, such as rafters, to ensure that the dimensions are within the permissible limits
- Estimating, planning, preparing and assigning the resources required for all mechanical and related works prior to execution
- Assigning targets for all mechanical tasks and ensuring that the targets are met on a daily basis
- Managing and providing engineering and technical support to all the mechanical work groups at the site
- Coordinating all mechanical-related works with the electrical and civil groups
- Submitting daily reports, inspection requests, estimates and all applicable monitoring reports on a regular basis or as required
- Collaborating with the cost control and planning department to prepare daily progress reports
- Attending regular meetings with other relevant parties on the construction project (6 × 1)

3.1 True

3.2 False. The function of mapping and measuring the land is the responsibility of the land surveyor

3.3 False. The structural engineer is responsible for the structural integrity of a construction project

3.4 False. The clerk of works is responsible for measuring and quality checking building materials

3.5 True (5 × 2) **[10]**

4.1 architects

4.2 – 4.4 private; commercial; government

4.5 needs

4.6 – 4.8 economical; functional; safe

4.9 – 4.10 contract administrator; principal agent (10 × 1)

Total: 50 marks

Module summary

In this module, students learnt the following:

- A client is the person who makes use of the advice or service of a professional
- The client provides the original idea for the project
- The client is financially responsible for the project
- There are three types of clients:
  - private clients;
  - commercial clients; and
  - government clients.
- A typical example of a private client project is additions to or the renovation of an existing house
- A typical example of a commercial client project is a business that requires the alteration of an existing building used in its daily operations
- A typical example of a government project is the construction of new roads or alterations to government buildings
- The main responsibilities of a client are the following:
  - Financing the project;
  - providing site surveys;
  - working with the relevant authorities and governing bodies;
  - authorising payments;
  - authorising plans and specifications;
  - providing any knowledge of the project that might not be readily available;
  - selecting the various required professionals;
  - collaborating with the various contractors; and
  - assisting with the sale of the property after project completion, should it be required.

- The architect interprets the client's idea and converts it into plan drawings and models
- The main responsibilities of an architect are the following:
  - interpreting the client's idea and finding a viable concept;
  - advising the client on the practicality of the project;
  - discussing the objectives, requirements and budget of a project with the client;
  - roughly estimating the project costs;
  - preparing and presenting feasibility reports and design proposals to the client; and
  - producing detailed workings, drawings and specifications.
- The quantity surveyor calculates the total cost of a project and is involved from the initial estimates to the final purchase of materials
- The quantity surveyor ensures that the client gets value for his/her money
- The quantity surveyor fulfils the role of negotiator, project coordinator and expense manager
- A quantity surveyor can specialise in certain areas of the construction industry, including the following:
  - property taxation;
  - costing advice; and
  - building maintenance.
- The main functions of a quantity surveyor are as follows:
  - studying the plans from the architect and the engineer and preparing a project cost estimate;
  - drawing up a feasibility report and analysing the returns expected from the building;
  - creating practical solutions and offering cost-saving advice to help the design team stay within their budget;
  - preparing the final detailed estimate of the costs (the bill of quantities) with the architect;
  - giving advice on tendering and contractual arrangements;
  - evaluating tenders and helping the client decide on the best tenderer for the job;
  - giving advice on insurance, responsibilities, warranties and bonds;
  - doing the technical auditing of the project;
  - preparing construction contracts;
  - preparing the statement of expenditure for tax and accounting purposes;

  - determining the value of the work done by the contractor to draw up the interim payment certificates;
  - putting cost-saving measures in place to minimise variations costs;
  - providing cash flow data to the client so that he/she can arrange the necessary finances for each phase of the project;
  - assessing the cost effects of a variation that might delay the project;
  - providing the bank with a project report when needed;
  - resolving disputes between various parties;
  - preparing the final account within 60 calendar days of practical completion;
  - preparing the final payment certificate; and
  - providing copies of all necessary documents.
- A structural engineer is responsible for the structural integrity aspect of the project
- Some of a structural engineer's responsibilities include the following:
  - investigating and surveying building sites to determine the suitability of the earth for the requirements of the upcoming project;
  - providing technical advice on the design and construction of a structure;
  - preparing designs, drawings and reports as required;
  - analysing the structural components and their configurations;
  - conducting ongoing inspections of a contractor's work to ensure that structural integrity is maintained;
  - making calculations regarding loads and stresses; and
  - liaising with relevant professional staff, such as the architect and other engineers.
- The role and responsibilities of a mechanical engineer typically include the following:
  - implementing and monitoring all on-site mechanical-related operations as per the approved drawings and safety rules;
  - designing all mechanical components, such as the **HVAC** and plumbing systems;
  - interpreting the construction drawings, contract documents and applicable standards or specifications before any work is done;
  - ensuring that all works done are in accordance with the approved construction drawings, contract documents and project specifications and all applicable health, safety, sanitary and environmental standards;
  - ensuring that the equipment is erected, precommissioned, tested and commissioned in accordance with the agreed contracts;
  - supervising the installation of machines and equipment on site;

  - going on regular site walks to ensure that the project is being built properly;
  - checking the dimensions of the incoming materials, such as rafters, to ensure that the dimensions are within the permissible limits;
  - estimating, planning, preparing and assigning the resources required for all mechanical and related works prior to execution;
  - assigning targets for all mechanical tasks and ensuring that the targets are met on a daily basis;
  - managing and providing engineering and technical support to all the mechanical work groups at the site;
  - coordinating all mechanical-related works with the electrical and civil groups;
  - submitting daily reports, inspection requests, estimates and all applicable monitoring reports on a regular basis or as required;
  - collaborating with the cost control and planning department to prepare daily progress reports; and
  - attending regular meetings with other relevant parties on the construction project.
- Due to the versatility of mechanical engineers, they are often project managers or in charge of project logistics
- The electrical engineer is responsible for all electrical work, such as the following:
  - carrying out feasibility studies for new technical developments;
  - designing electrical systems and project blueprints for the construction project;
  - drawing up project plans and producing models, prototypes and circuit diagrams for high- and low-voltage electrical equipment;
  - preparing cost estimates for materials and labour before construction begins;
  - managing the construction schedules;
  - managing and overseeing teams of electrical contractors;
  - interacting with the construction teams to identify and resolve development issues;
  - ensuring that the electrical installation and operations conform to standards and customer requirements; and
  - testing all electrical systems.
- A land surveyor is responsible for mapping and measuring the land to be used for the construction project

- There are two types of land surveyors in the construction industry:
  - construction or engineering surveyors; and
  - boundary surveyors.
- Data gathered by the land surveyor are used to monitor any changes in the land condition during the construction process
- A building inspector ensures that the contractors comply with:
  - national building regulations;
  - zoning regulations; and
  - plan specifications.
- The building inspector also ensures that the working environment on site is safe for contractors as well as the end users of the structure
- Typical responsibilities of a building inspector include the following:
  - approving building plans;
  - checking the structural quality and general safety of buildings;
  - checking that all electrical, plumbing and HVAC are within regulation;
  - issuing violation notices and stop orders; and
  - performing inspections on completed projects and providing feedback.
- A clerk of works represents the client's interests and is employed by the client or the architect
- The clerk of works is responsible for the following:
  - checking the quality of the workmanship;
  - ensuring that the building regulations and health, safety, legal and ecological requirements are met;
  - ensuring that the work is done according to the specifications, building plans and engineering drawings;
  - identifying defects and suggesting ways to correct them;
  - checking the drawings and specifications for errors and discrepancies and reporting these to the architect;
  - measuring and quality checking building materials, e.g. cement, steel and aggregate;
  - keeping detailed records of the work, weather conditions, labour force, plant and machines on site, etc.;
  - liaising with the client, contractors, engineers and surveyors;
  - checking that building regulations and health, safety, legal and ecological requirements are met; and
  - providing the construction managers, architect and client with a report on the status of the project.

2 *Building firms*

By the end of this module, students should be able to:

- explain the structure and operating functions of the following types of firms:
  - small
  - medium
  - large;
- explain the following methods used to obtain business opportunities:
  - recommendation
  - reputation
  - advertising
  - arrangement
  - tendering; and
- distinguish between the roles and responsibilities of the following construction firm departments:
  - contracts
  - estimation
  - costing
  - buying
  - plant and maintenance
  - accounts
  - human resources.

Whether it is an alteration, renovation, maintenance or even demolition, any construction work is considered a construction project. However, all construction projects are not the same and differ according to how the need for the work came to light, how the project must be approached and who is responsible for each facet of the project. In this module, you will learn about the different types of construction firms, how these firms acquire construction work and the different departments within these firms that contribute to a successful construction project.

Exercise 2.1

SB page 28

1.1 False. The foreman reports directly to the site engineer

1.2 True
1.3 True
1.4 False. The cleaning falls under the responsibility of the Administration Department
1.5 True (5 × 1)

2. Any TWO of the following:
   - House construction
   - Additions to existing structures
   - Renovating existing structures
   - Maintenance and repair (2 × 1)

3. The board of directors represents the stockholders of the firm and is headed by a managing director. The board is responsible for the following: (5)
   - The long-term vision and strategy of the firm
   - Ensuring the stockholders a return on their investment
   - Appointing and communicating with the CEO

4. Any THREE relevant responsibilities:
   - Site preparation
   - Bricklaying
   - Paintwork (3 × 1)

5.1 C
5.2 B
5.3 B
5.4 A
5.5 C (5)

Total: 20 marks

Exercise 2.2 SB page 33

1.1 True
1.2 False. The Costing Department is responsible for capturing the costs of work completed
1.3 True
1.4 False. Project construction can be brought to a stop if the Buying Department does not ensure the timely delivery of material
1.5 False. When a personnel dispute arises during a project, the HR Department must resolve it (5 × 1)

2.
- Labour
- Transport
- Materials
- Equipment (4 × 1)

3. This rate is sourced from similar projects that have been completed in the past and supplied by the Costing Department (2)

4.
- Procuring equipment
- Hiring equipment
- Renting out equipment
- Selling equipment (4)

Total: 15 marks

Exercise 2.3 SB page 36

1.1 Advertising
1.2 Recommendation
1.3 Arrangement
1.4 Tender
1.5 Reputation (5 × 1)

2. Any THREE of the following:
- Broadcasting: television and radio
- Print: newspapers and magazines
- Direct mail to a post box
- Telephone
- Signage such as billboards
- Vehicle branding (3 × 1)

3. An open tender is open to all construction firms. This type of tender is normally advertised in local or national newspapers and trade magazines. If it is a government tender, it is published in the Government Gazette. It is the most competitive type of tender.

A closed tender is only available to specific construction firms. Firms are invited to quote on a tender based on their experience and reputation. This tender process is normally used for specialised services and is commonly used by the private sector. (2 × 2)

4. The rotation method entails the client keeping a list of reputable building firms and inviting only a few firms at a time. Other firms are invited to quote with the next tender, rotating through the list. (3)

Total: 15 marks

Group activity 2: Site visit

SB page 37

Before this module starts, organise a site visit to a nearby construction site.

- Look for a construction site situated close to the college/in the area. It can be a anything from a small site such as someone who is building a room onto their house, a medium construction site, or a large construction site
- Make sure you get permission from the owner of the site/main contractor to bring the students on-site
- Make sure that you know what the safety requirements are and what PPE the students will need
- Get permission from the campus head/department head to take the student on a site visit
- Arrange for permission letter to be drawn up for the students' parents/guardians to sign
- Arrange transport
- Explain to the students beforehand what information they need to gather while they are on-site (the questions are in the Student Book)
- After the site visit, divide the class into chat groups (four students in a group) and let them discuss their findings from the site visit

Summative assessment

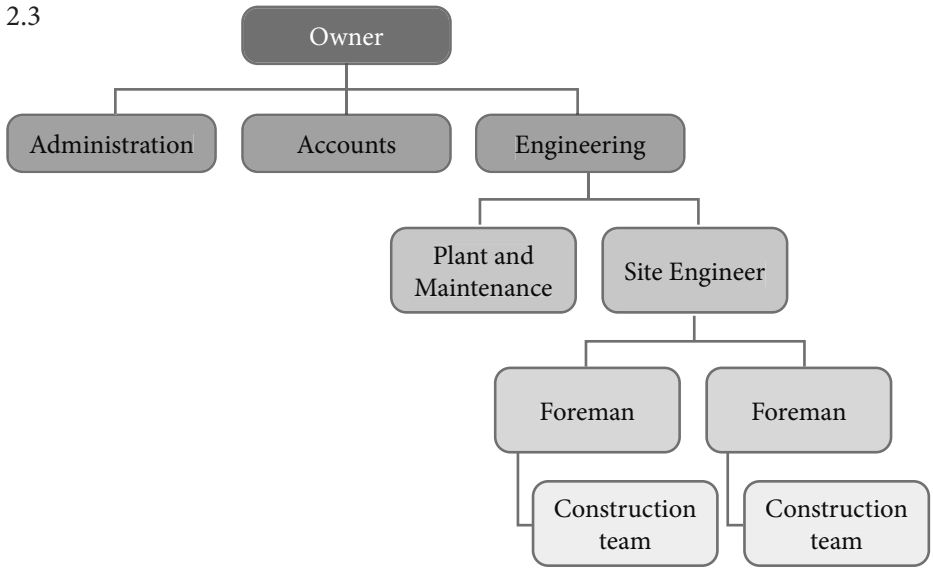
SB page 40

1.1 B
1.2 D
1.3 A
1.4 C
1.5 B
1.6 C
1.7 B
1.8 A
1.9 D
1.10 C (10 × 1)

2.1
- Houses
- Small housing complexes
- Small blocks of flats
- Small shopping centres (4 × 1)

2.2 Any THREE of the following:
- Supervising all work being done by the construction team
- Communicating with the various contractors on site
- Reporting back to the manager regularly
- Procuring required building materials as needed (3 × 1)

2.3



(11)

2.4 Any THREE of the following:
- Business website: The business website is not used as an advertisement itself, but rather to provide more information, contact details and pricing on the product or service provided. The website is advertised by appearing on social media, search engines, emails or mobile advertising.
- Social media: Websites and apps such as Facebook, Twitter, Instagram, Pinterest and Snapchat are used, for example, to place endorsements by celebrities and influencers for a specific service or product.
- Email: Email is used as a direct marketing approach, emailing potential clients after showing interest in similar services. The email addresses are normally gathered by the users signing up to receive information such as a monthly newsletter.

- Search engines: Search engines such as Google sell an advertisement service, e.g. Google AdWords. This service enables advertisers to pay to display brief advertisements, service offerings, product listings and video content within the Google ad network to web users. The AdWords system is based on a users current and previous internet searches, where the information is used to recommend websites of businesses that offer what the client is interested in.
- Mobile: Mobile marketing works in a similar way to email, where the advertisement is sent to your phone in a short and to-the-point message. It often contains a link to a website of the specific business offering the service or product. (6)

2.5 Buying Department (1)

Total: 35 marks

Module summary

In this module, students learnt the following:

- Construction firms and the respective projects in which they specialise can be divided according to size: small, medium and large
- Small construction firms specialise in projects such as:
  - house construction;
  - additions to existing structures;
  - renovating existing structures; and
  - maintenance and repair.
- A small construction firm consists of the following role players with their respective responsibilities:
  - owner:
    - manages the business;
    - communicates with the client;
    - plans and supervises the projects; and
    - procures the building materials.
  - tradesmen:
    - Perform the work in which they specialise, such as tiling, bricklaying and roofing.
  - labourers:
    - often unskilled labour that accompany the tradesmen.

- Medium construction firms specialise in projects such as the following:
  - private houses;
  - small housing complexes;
  - small blocks of flats; and
  - small shopping centres.
- A medium construction firm consists of the following role players with their respective responsibilities:
  - owner or manager:
    - manages the business;
    - communicates with the client;
    - communicates with the foreman;
    - appoints the various professionals; and
    - conducts regular site visits.
  - foreman:
    - supervises the work done by the construction team
    - communicates with contractors on site
    - reports to the manager on the project status
    - procures required building materials.
  - construction team consisting of tradesman and labourers:
    - site preparation;
    - bricklaying;
    - paintwork; and
    - tiling.
- Large construction firms specialise in projects such as:
  - housing complexes;
  - blocks of flats;
  - skyscrapers;
  - shopping malls;
  - roads; and
  - bridges.
- Large firms are owned by stockholders who are represented by a board of directors
- The directors, via the managing director, are responsible for:
  - the long-term vision and strategy of the firm;
  - ensuring the stockholders a return on their investment; and
  - appointing and communicating with the CEO.

- The CEO is responsible for:
  - managing the firm's overall resources and operations;
  - communicating with the board of directors;
  - communicating with the management team, consisting of the various department heads;
  - assessing risks to the company and managing them; and
  - setting measurable strategic goals.
- The management team consists of the following departments:
  - Administration: This department handles all administrative tasks, ranging from IT and human resources to reception and cleaning;
  - Finance: The Finance Department handles all the finance-related activities, which include logistics and procurement;
  - Engineering: This department is at the head of the construction projects and consists of the following positions:
    - project planner;
    - safety manager;
    - projects manager;
    - designer and surveyor;
    - plant manager; and
    - site engineer.
  - Business Development: The Business Development Department is responsible for growing the company and acquiring new projects via various methods;
- The site engineer is responsible for managing the site and reports to the project manager
  - the foreman is responsible for:
    - supervising all work being done by the construction team;
    - communicating with the various contractors on site;
    - reporting back to the site engineer regularly; and
    - procuring required building materials as needed.
  - the construction team, consisting of the various tradesmen and labourers, is responsible for most of the work.
- The different departments of a typical large construction firm include the following:
  - Contracts: responsible for:
    - negotiation of contract terms;
    - compiling the contract documents; and
    - handling any contract-related issues.

  - Estimation: responsible for the estimation of projects when the firm is tendering for business;
  - Costing: responsible for recording the actual costs of sections of work as they are completed;
  - Buying: responsible for buying the construction materials and equipment; also in charge of hiring, renting out and selling equipment;
  - Plant and Maintenance: responsible for the service and maintenance of all equipment owned by the firm;
  - Accounts: responsible for paying the invoices received; and
  - Human Resources: responsible for managing the personnel of the firm.
- The most common methods used to get business are as follows:
  - recommendation: satisfied clients recommend a builder to acquaintances.
  - reputation: firms that provide quality service and good workmanship receive positive recommendations, increasing a strong reputation;
  - advertising: the firm attracts attention to a product, service or business by using:
    - traditional advertising channels; and/or
    - digital media advertising.
  - Arrangement: a standing agreement, in the form of a contract, is established between two companies;
  - Tendering: this is the process where a client company selects the best construction firm out of several competing firms. There are two types of tenders:
    - open tenders; and
    - closed tenders, such as rotation, requests and negotiated tenders.

3 Site preparation

By the end of this module, you should be able to:

- describe the roles of the various construction teams on a building site:
  - contracts manager
  - projects manager
  - general foreman
  - trades foreman
  - artisans
  - labourers
  - operators
  - subcontractors
  - storekeeper
  - gate watchman;
- list the following preliminaries and explain how they factor into site preparation:
  - access roads
  - demolition of existing structures
  - entry and exit controls
  - hoardings
  - security
  - site clearance
  - drainage
  - vegetation
  - electricity/water
  - soil testing
  - site signage boards;
- sketch and label a proper site layout plan taking into account the location of the following:
  - storage area
  - site office
  - plant location
  - ablution facilities
  - health and safety office; and
- explain the regulations regarding the following:
  - covered walkways
  - temporary roads
  - traffic control
  - the use of cranes
  - protection orders
  - adjoining properties
  - approval from local authorities.

Planning and scheduling form a large and important part of managing a construction project. Planning and scheduling all the construction activities and possible pitfalls will lead to completing the project on time and within budget. A proper planning process includes site organisation, which covers site rules, traffic management, safety aspects and storage and waste management. In this module, you will learn about the different aspects of site preparation, how to sketch and label a site layout plan and about regulations regarding walkways, temporary roads, adjoining properties and approval from local authorities.

Exercise 3.1

SB page 54

1.1 access road
1.2 CCTV
1.3 subsurface
1.4 specific gravity
1.5 OANs (5 × 1)

2.
- The durability of the road
- How much traffic it must be able to handle
- The maintenance the road may need (3 × 1)

3.
- Demolition of existing structures: All existing structures must be broken down and the rubble must be removed from the site or recycled
- Vegetation removal: Any non-protected trees must be removed if necessary and all grass and other vegetation must be removed from the site
- Soil clearing: The top layer of soil is often removed along with the vegetation to limit plant growth under newly constructed structures

(3 × 2)

4. Any ONE of the following:
- Electricity
- Water
- Sewerage
- Telephone/Internet (1)

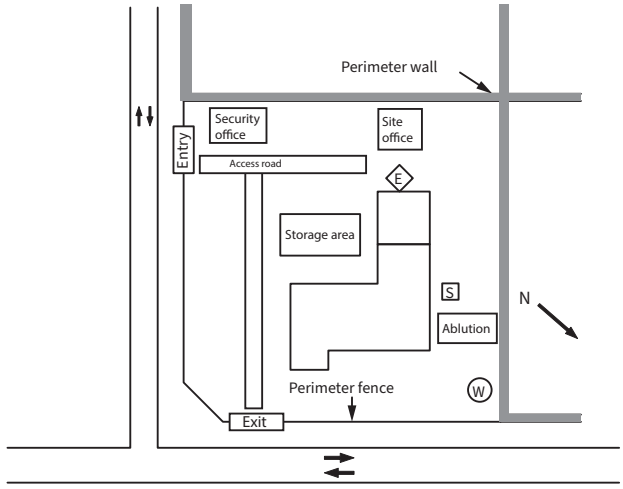
Total: 15 marks

Exercise 3.2

SB page 63

1.1 True
1.2 True
1.3 False. The interrelationships between the facilities refer to the usage of facilities and the travel or movement required between them
1.4 False. An official site plan is normally drawn up by the architect or another professional, as it needs to be exact and to scale
1.5 True (5 × 1)

2.



Any FIVE of the following placed at a logical location with good reasons.
Reasons for the placement:

- Site office: A small site office is placed near the electrical point, with enough space for parking, while being close to the access road
- Ablution facilities: The ablution facilities are placed close to the sewerage and water connection points
- Storage area: The storage area is close to the building works and the access road, making the site more efficient
- Exit gate: A second gate to be used as an exit is placed on the northern fence. This will ease any traffic on site
- Security office: Because it is an embassy building, a small security office is placed at the entry gate
- Access road: The access road runs right around the building site, providing access to every part. The road also runs past the storage area, which enables the loading and offloading of material (15)

Total: 20 marks

Exercise 3.3

SB page 70

1.1 C
1.2 D
1.3 E
1.4 A
1.5 B (5 × 1)

2.
- Temporary walkways must be covered to prevent falling debris from injuring pedestrians, should demolition occur within 3 m of the property border
- The walkway cover must stretch the whole walkway and be securely fixed without any gaps in it
- The walkway cover must also have rails to prevent the debris lying on it from falling off
- Temporary walkways and their covers must be kept in a good condition throughout the project and must therefore be regularly maintained (4 × 1)

3.
- They must know where to stand
- They must know how to slow traffic
- They must know how to coordinate public and construction traffic movements (3 × 1)

4.
- A load indicator
- A limiting device (2 × 1)

5. Wait for approval and make the necessary amendments to the documentation as directed by the municipality (1)

Total: 15 marks

Pair activity 1

SB page 71

The students must be divided into pairs.

Working together, the students must firstly discuss the scenario and then make a rough freehand drawing(s) until both students are happy with the layout.

One of the students then sketches the final site layout plan, while the other student makes notes of their reasons for the placement of the facilities and equipment.

When that is done, two groups get together discuss their respective projects using the following guidelines:

- How do their site layouts differ?
- Why do they differ? Are the reasons for these differences reasonable?
- What conclusion can they reach from what they have learnt?

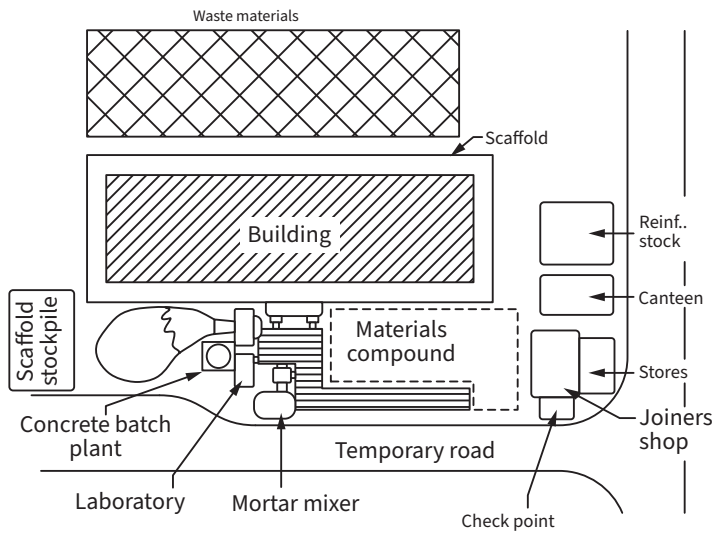
Summative assessment

SB page 76

1.1 C
1.2 B
1.3 A
1.4 D
1.5 B
1.6 D
1.7 C
1.8 A
1.9 C
1.10 B (10 × 1)

2.1 Any relevant criticism, e.g.:
- Hoists: The hoists are too far apart
- Material stockpiles: The materials stockpiles are too far from the hoists
- Access roads: There is very limited access to the building site, as facilities surround it (3 × 1)

2.2 Any logical layout showing the changes based on the answer in QUESTION 2.1.



(15)

3.1 Any FIVE of the following:

- There must be sufficient road signs
- The road signs must be clean to increase their visibility
- Old or unnecessary traffic signs must be removed so that drivers do not get confused
- Workers who control the traffic must be well trained and must know where to stand, how to slow traffic down and how to coordinate public and construction traffic movements
- Traffic controllers must use two-way radios when visual contact is not possible
- All workers moving around the construction site must wear high-visibility clothing to ensure that vehicles see them
- Speed limits must be consistent with safe site operations and traffic movements (5 × 1)

3.2 Any FIVE of the following:

- Building plans approval application form
- SACAP registration form
- Copy of the property title deed
- Power of attorney for the architect to submit the plans
- The Surveyor General diagram, along with a zoning certificate, a contour map and an aerial view of the property
- Approval stamps from other relevant authorities, such as the fire department and the environmental health authority
- An engineering certificate of appointment/completion
- An official building line relaxation permission or rezoning consent form from a town-planning authority
- An approved site development plan
- The property's water and sanitation layout
- A heritage approval stamp from the Council should work be conducted on buildings built before 1951 (5 × 1)

3.3 Protection orders refer to the conservation regulations that aim to protect the natural and man-made beauty of an area. Laws require construction companies to conduct impact studies that cover the following:

- Ground and surface water pollution
- Dust pollution
- Noise pollution
- Animal habitats affected
- Plant species that may be affected (7)

Total: 45 marks

Module summary

In this module, students learnt the following:

- A site must first be prepared before construction can start
- The preliminaries of site preparation are the following:
  - access roads;
  - demolition of existing structures;
  - entry and exit controls;
  - hoardings;
  - security;
  - site clearance;
  - drainage;
  - vegetation;
  - electricity/water;
  - soil testing; and
  - site signage boards.
- Access roads are temporary roads used by the construction team and all other authorised personnel to gain access to the construction site
- There are several factors to consider when access roads are planned
- The type of access road chosen takes into account its durability, the amount of traffic and the required maintenance
- Security on a construction site helps to prevent vandalism, theft and injury
- Common security measures that are often used on and around constructions sites include the following:
  - perimeter security;
  - signage;
  - lighting;
  - CCTV;
  - OANs; and
  - GPS tracking.
- The type of site clearance activities depends largely on the type of project
- Common site clearance activities include the following:
  - demolition of existing structures;
  - vegetation removal; and
  - soil clearing.
- Drainage systems are used to lead away surface water such as rain or subsurface water coming from the underlying water table

- Utilities are the services that local government supply to the area and include:
  - electricity;
  - water;
  - sewerage; and
  - telephone/Internet.
- A soil test normally forms part of the land-surveying aspect of a project
- Soil tests that are not properly conducted may lead to the building collapsing or leaning
- Commonly used soil tests are as follows:
  - moisture content test;
  - specific gravity test;
  - dry density test; and
  - compaction test.
- A site layout plan is a tool used by construction management to manage the site's layout efficiently
- Properly planned site layout may lead to:
  - work being undertaken efficiently and safely;
  - a reduction in travel times;
  - a reduction in site congestion; and
  - higher worker morale.
- Poor site layout planning may lead to:
  - inappropriate storage of materials;
  - inadequate movement space;
  - unsatisfactory access to the site;
  - security issues; and
  - safety issues.
- Required facilities that provide in the basic needs of the workers include:
  - ablution facilities;
  - drinking water;
  - locker rooms; and
  - rest facilities.
- The steps in a site layout plan process are the following:
  - consider access to the site;
  - identify the required site facilities;
  - determine the sizes of the required facilities;
  - establish the interrelationships between facilities;

  - optimise the layout of the facilities on site; and
  - draw the site layout plan.
- The National Building Regulations are standards that act as practical guidelines to ensure the health and safety of everyone working on, in and around the structure
- Covered walkways are demarcated walkways that must be used to ensure worker safety
- Temporary roads around a construction site must be carefully planned so that accidents can be avoided
- Traffic controllers must be well trained and use two-way radios when visual contact is not possible
- Tower cranes are commonly found on construction sites to lift and move very heavy materials that can potentially be dangerous
- Protection orders refer to the conservation regulations that aim to protect the natural and man-made beauty of an area
- Adjoining properties can be affected by construction, as construction activities go hand in hand with noise and dust pollution
- Approval from the local municipality must be obtained before any construction work may begin

4 Planning and programming

By the end of this module, students should be able to:

- explain the various types of planning and the factors to be considered in each of the following:
  - six steps to programming
  - financial planning
  - personnel planning
  - organisational planning
  - stage and period planning
  - the importance of planning; and
- plot construction activities and time on a Gantt chart and show how progress is measured using it.

A construction project can be defined as a series of related tasks that are completed in a certain order. Any project can therefore be broken down into small, related tasks with small projects having less tasks to complete.

Exercise 4.1

SB page 92

1.1 Financial planning
1.2 Organisational planning
1.3 Programming
1.4 Personnel planning
1.5 Stage and period planning (5 × 1)

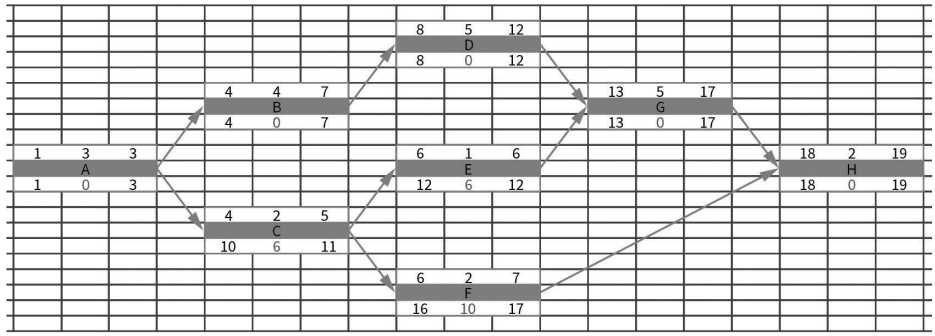
2. Any THREE of the following:
   - Poor time management
   - Unclear project objectives
   - Budget issues
   - Unsatisfied clients
   - Unsupportive stakeholders (3 × 1)

3.
- Plan the schedule management
- Define the activities
- Sequence the activities
- Estimate the activity resources
- Estimate the duration of the activities
- Develop the schedule (6 × 1)

4. The following FOUR types, with any suitable examples:
- Finish-to-start (FS): Task X has to finish before task Y can start
- Finish-to-finish (FF): Task X has to finish before task Y can finish
- Start-to-start (SS): Task X has start before task Y can start
- Start-to-finish (SF): Task X has to start before task Y can finish (8)

5. This method is used when there are little data available. It relies on the average duration of a best case scenario, a worst case scenario and a most likely scenario (3)

6.



(35)

Marking guideline

Activities in the correct sequence	10
Durations correctly assigned	4
Forward pass correctly calculated	8
Backward pass correctly calculated	8
Critical path correct	5

Total: 60 marks

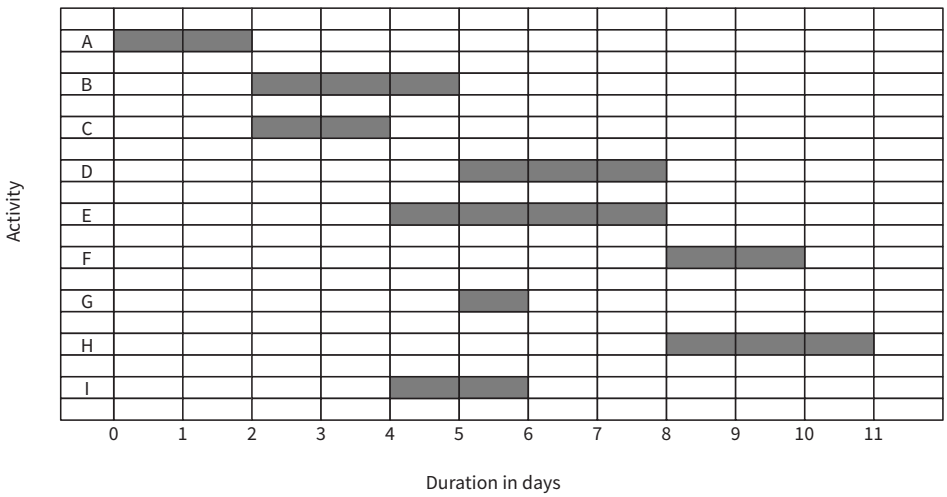
Exercise 4.2

SB page 100

1. A Gantt chart is a type of bar chart that provides a project overview to the stakeholders (2)

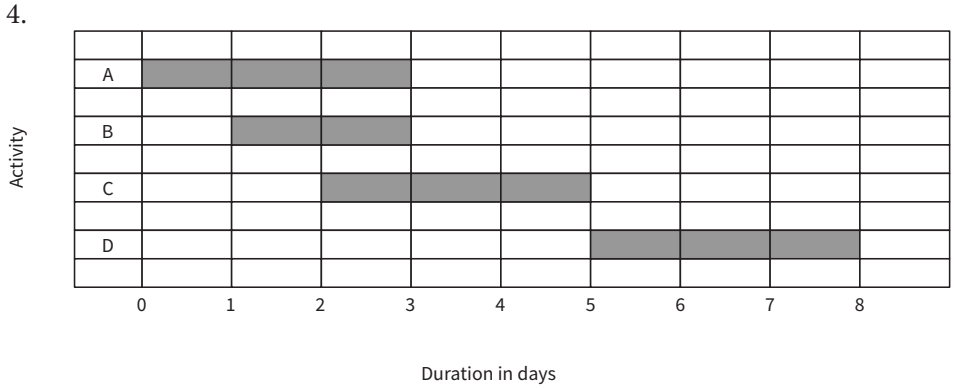
2.
- Task list
- Task start and finish dates
- Duration of tasks
- Project milestone dates
- Project start and finish dates (5 × 1)

3.



(10)

4.



(8)

Total: 25 marks

Pair activity 2

SB page 101

The students must be grouped into pairs.
After reading through the scenario and information, the students must:

- Define the activities and draw up a task list
- Identify the task dependencies
- Estimate the duration of the activities
- Draw up a Gantt chart

The following are possible answers to the tasks.
Step 1: Define the activities and draw up a task list.

Task ID	Task description
110	Removal of vegetation
120	Soil clearing
130	Excavations
210	Placing steel reinforcement
220	Pouring concrete
310	Marking out wall locations
320	Building the walls
330	Plastering the walls
340	Pouring screed
410	Building the roof trusses on-site and fitting them
420	Placing the roof covering and tiles
440	Installing ceiling boards
510	Electrical work
520	Plumbing work
610	Hanging doors
620	Installing window glazing
630	Installing toilets
640	Installing showers
650	Installing basins
660	Installing kitchen cupboards
670	Installing kitchen sink and all taps
680	All interior tiling
690	All painting (interior and exterior)

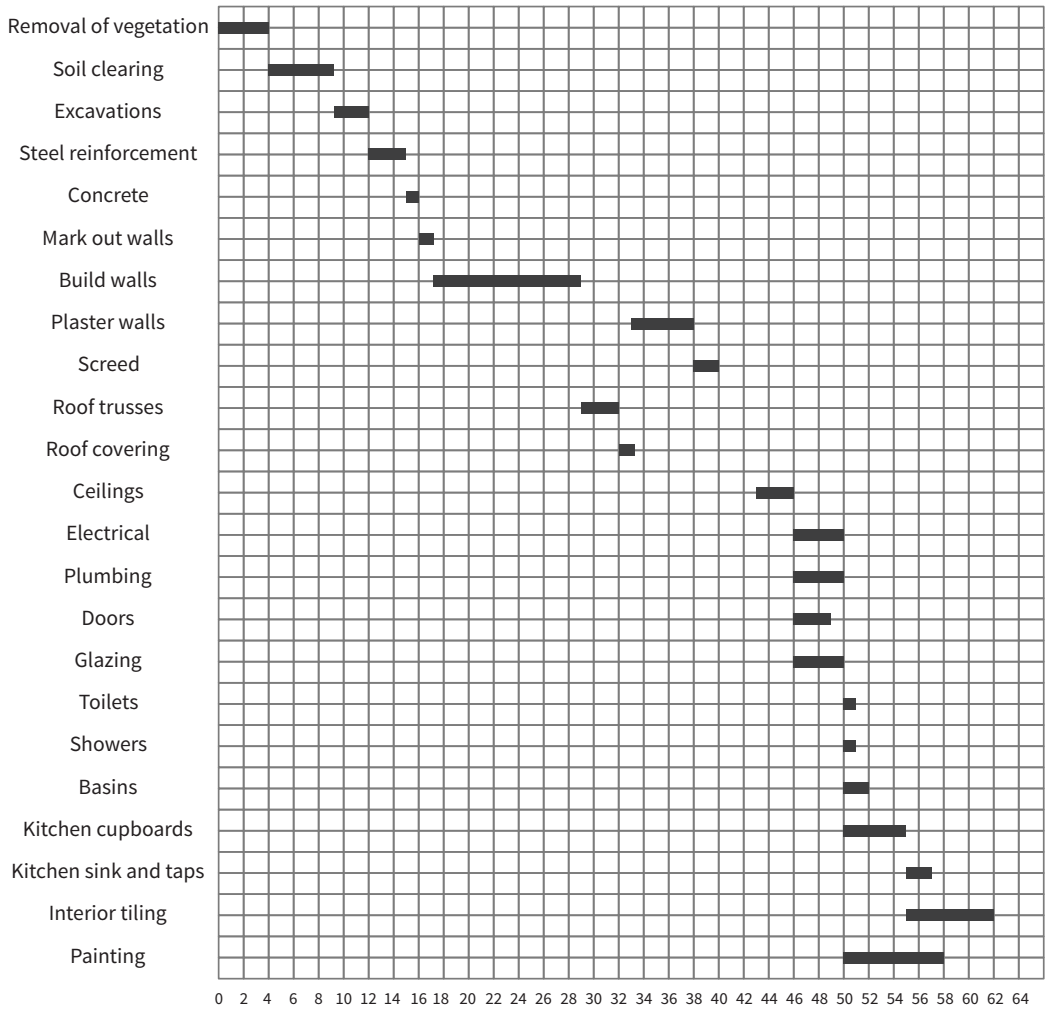
Step 2: Identify task dependencies.

Task ID	Description	Dependency
110	Removal of vegetation	-
120	Soil clearing	110
130	Excavations	120
210	Placing steel reinforcement	130
220	Pouring concrete	210
310	Marking out wall locations	220
320	Building the walls	310
330	Plastering the walls	320, 420
340	Pouring screed	330, 420
410	Building the roof trusses on-site and fitting them	320
420	Placing the roof covering and tiles	410
430	Installing ceiling boards	420
510	Electrical work	430
520	Plumbing work	430
610	Hanging doors	430
620	Installing window glazing	430
630	Installing toilets	520
640	Installing showers	520
650	Installing basins	520
660	Installing kitchen cupboards	620
670	Installing kitchen sink and all taps	520, 660
680	All interior tiling	510, 520
690	All painting (interior and exterior)	510, 520

Step 3: Estimate task durations.

Task ID	Description	Dependency	Durations
110	Removal of vegetation	-	4
120	Soil clearing	110	5
130	Excavations	120	3
210	Placing steel reinforcement	130	3
220	Pouring concrete	210	1
310	Marking out wall locations	220	1
320	Building the walls	310	12
330	Plastering the walls	320, 420	5
340	Pouring screed	330, 420	2
410	Building the roof trusses on-site and fitting them	320	3
420	Placing the roof covering and tiles	410	1
430	Installing ceiling boards	420	3
510	Electrical work	430	4
520	Plumbing work	430	4
610	Hanging doors	430	3
620	Installing window glazing	430	4
630	Installing toilets	520	1
640	Installing showers	520	1
650	Installing basins	520	2
660	Installing kitchen cupboards	620	5
670	Installing kitchen sink and all taps	520, 660	2
680	All interior tiling	660	7
690	All painting (interior and exterior)	620	8

Step 4: Draw up the Gantt chart.



Gantt chart

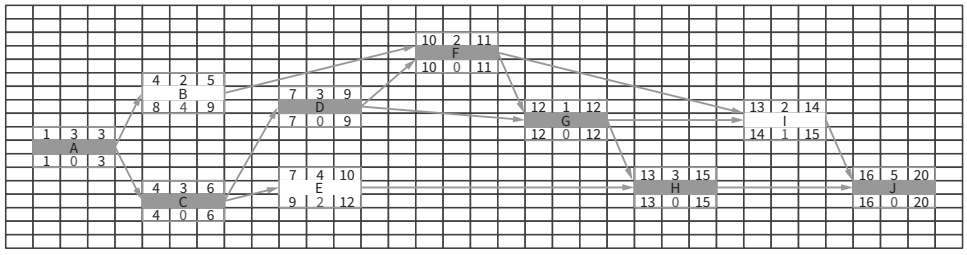
Summative assessment

SB page 106

1.1 B
1.2 C
1.3 D
1.4 A
1.5 B
1.6 C
1.7 D
1.8 B
1.9 A
1.10 C (10 × 1)

2.1 The amount of time an activity can be delayed without having an effect on the activities that follow (1)

2.2



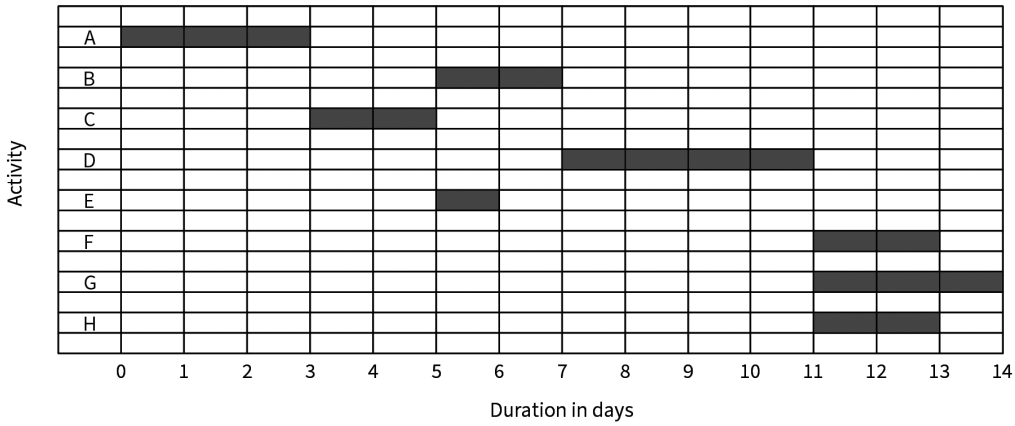
Marking guideline

Activities in the correct sequence	12
Durations correctly assigned	5
Forward pass correctly calculated	10
Backward pass correctly calculated	10
Critical path correct	7

(44)

3.1 Step 1: Define the activities and draw up a task list
Step 2: Identify the task dependencies
Step 3: Estimate the duration of the tasks
Step 4: Draw and fill out the chart axes
Step 5: Plot the information on the chart (5 × 1)

3.2



(15)

Total: 75 marks

Module summary

In this module, students learnt the following:

- Proper planning of a project limits problems and increases efficiency
- A plan lays out every step of the construction project and serves as a framework for the project manager to follow
- The consequences of poor project planning include the following:
  - poor time management;
  - unclear project objectives;
  - budget issues;
  - unsatisfied clients; and
  - unsupportive stakeholders.
- A good project plan covers the following factors:
  - programming, which refers to the overall project schedule;
  - financial planning, which refers to the project budget and all related project costs;
  - personnel planning, which specifies the personnel involved in the project;
  - organisational planning, which specifies when certain personnel are expected on site; and
  - stage and period planning, which refers to the different stages of a project and the activities that must be completed in each stage.

- Programming refers to the sequence in which a series of tasks must be carried out in order to complete a project
- Programming consists of the following six steps:
  - plan the schedule management;
  - define the activities;
  - sequence the activities;
  - estimate the activity resources;
  - estimate the duration of the activities; and
  - develop the schedule.
- Planning how the schedule will be managed is accomplished by defining supporting documentation such as policies and procedures
- The planning of schedule management covers items such as:
  - contingencies;
  - resources;
  - task dependencies;
  - organisational procedures; and
  - stakeholders.
- Defining activities entails identifying and documenting every task required to produce project deliverables
- Defined activities are captured on a task list or diagram
- Each task must:
  - be accurately estimated based on the cost or duration;
  - have a clearly defined milestone;
  - have a specific person responsible for its completion; and
  - be measurable in terms of progress.
- The relationships between tasks are defined based on the following dependencies:
  - finish-to-start (FS);
  - finish-to-finish (FF);
  - start-to-start (SS); and
  - start-to-finish (SF).
- Task relationships can then be further defined based on the offset point of each task, which can either be lead or lag
- The estimation of activity resources consists of estimating the cost of whatever is needed to complete a specific task

- There are four main types of resources:
  - labour;
  - equipment;
  - facilities; and
  - fixed costs.
- Activity duration estimations take the availability of resources into account
- Three methods are used to estimate activity duration:
  - analogous estimation;
  - parametric estimation; and
  - three-point estimation.
- The information gathered through steps 1 to 5 is used to develop a schedule in the form of a network diagram
- A network diagram can be drawn by completing the following steps:
  - draw the diagram based on the task dependencies;
  - add the duration of each task;
  - do a forward pass to determine the ES and LS of each task;
  - do a backward pass to determine the EF and LF of each task; and
  - determine the float or slack for each task.
- The critical activities and critical path of the project can be identified using the float
- Gantt charts provide an overview of the project and progress of the activities to all stakeholders
- Gantt charts provide information regarding the following:
  - task list;
  - task start and finish dates;
  - duration of tasks;
  - project milestone dates; and
  - project start and finish dates.
- The process of drawing a Gantt chart consists of the following five steps:
  - define the activities and draw up a task list;
  - identify the task dependencies;
  - estimate the duration of the tasks;
  - draw and fill out the chart axes; and
  - plot the information on the chart.
- The relationships between activities are often denoted as "Activity (relationship, lag)"
- If an activity does not specify a relationship, you can assume a FS relationship to apply

5 *Building materials*

By the end of this module, students should be able to:

- describe the procedure to be followed regarding the following:
  - ordering and receiving material
  - following up on orders
  - storing various materials
  - cost and quality
- differentiate and understand the use of the following documents:
  - order form
  - requisition form
  - delivery note
  - invoice
  - receipt
- explain how to reduce wastage on-site due to:
  - control waste
  - improper storage
  - improper handling
  - damage of material on delivery
  - theft.

During the New Stone Age, roughly from 9 000 BC to 5 000 BC, commonly used building materials included the rib bones of mammoths, animal hide, clay and natural wood. Luckily, as humans and the building industry evolved, the search for building materials became somewhat simpler. Even though building materials are easily accessible, the managing process of getting materials from the suppliers to the site can become tricky, especially if you consider that not only must the timing of the delivery be perfect, but so too must the quantity and quality – all at the best price, of course. The previous modules have touched on materials regarding their storage location on site and how their availability can influence the progress of a project. This module not only focuses on the procedures of ordering and receiving material, storage methods, cost and quality, but also on the different support documents that are used and ultimately, how wastage on site can be reduced.

Exercise 5.1

SB page 118

1.1 C
1.2 E
1.3 A
1.4 B
1.5 D (5 × 1)

2.1 The ends of all timber members must be coated to prevent them from cracking, using coal tar, aluminium leaf paints or micro crystalline wax (2)
2.2 The ends of the bars must be painted in different colours to indicate the different classes (2)

3. For cement, the floor of the store must consist of concrete or two layers of dry bricks over well-consolidated earth
For bricks, only firm ground is required (3)

4.
- Material requirement determined by procurement engineer
- Materials list compiled and sent to material engineer
- Materials list submitted for approval to project engineer
- Procurement notified:
  - suppliers chosen and contacted; and
  - storage Department contacted.
- Storage Department contacts Quality Department
- Delivered materials received by quality engineer and store foreman
- Materials distributed to relevant site locations as required (9)

5.
- Operating inventory is materials that are used to conduct the construction work or maintain equipment needed to conduct the work. This may include tools and consumable inventory such as nuts, bolts, screws, nails, wire, etc.
- Building material is the material used to construct and may include cement, aggregate, timber and steel (4)

Total: 25 marks

Exercise 5.2

SB page 125

1.1 True

1.2 False. To acquire the 10 m^3 aggregate that a project requires, a purchase order is sent to the supplying company

1.3 False. Once an order has been accepted, the supplier sends an invoice to the company that placed the order

1.4 False. An invoice reflects the invoice number as well as payment instructions

(4 × 2)

2. A: Project name
B: Project address
C: Seller's name
D: Seller's representative
E: Seller's address
F: Tax rate
G: Buyer's authorised signature
H: Buyer's printed name (8 × 1)

3. Any FOUR of the following:
- Name and contact details of the supplier
- Name and contact details of the customer
- Date of issue
- Date of delivery
- Corresponding invoice number
- Corresponding purchase order
- Name of the person who placed the order
- Description of the materials that are being delivered
- Quantities of the materials that are being delivered
- Empty field for the receiver's name and signature
- Empty field for the date and time the delivery is received

(4)

Total: 20 marks

Exercise 5.3

SB page 130

1. Waste management aims to control and limit the amount of material waste during construction activities (1)

2.
   - Altered designs: When material is procured for a specific design and the design changes, material will be wasted. Some suppliers may have an option to return unused material in a sellable condition
   - Procurement activities: When planning is not done properly and the deliverables are not clearly defined, excess or unnecessary materials are procured and ultimately wasted (4)

3.
   - The exact amount/number of materials needed for the job
   - How often material levels will be checked to make sure that there are no excess purchases
   - What materials are available on site already (3 × 1)

4. Any TWO of the following:
   - Planning
   - Proper handling
   - Reducing errors
   - New technologies (2 × 1)

Total: 10 marks

Group activity 3: Role play

SB page 130

The purpose of this roleplay is to give the students the practical experience of knowing which forms to fill in, when, and how as well as to test their knowledge on how to store various building materials. This roleplay is an example of how it can be done in a fun and practical way. You can, however, add your own ideas to make it better.

Divide the class into groups of FIVE with each student playing one of the following roles:

- Contractor
- Stoor foreman
- Supply store manager
- Procurement clerk
- Delivery man

To make this role play more realistic, you can place tables and chairs for each persona. Give the students' props to make them identifiable to the role they are playing, for example:

- Contractor has some sort of tool on his belt or wears a hard hat
- Store manager wears an apron or overall
- Supply store manager has a cash register on his desk
- Procurement manager has "fake money" on his desk
- Delivery man has a keyring with keys for their "truck"

Note: You can tell the students about the roll play the previous day, divide them into groups and let each one bring something from home if they can.

Instead of having to draw up their own forms, print copies of the various forms which the students will need to fill out.

You can also have building materials available if should the campus construction store keep stock.

Summative assessment

SB page 135

1.1 D
1.2 D
1.3 B
1.4 C
1.5 A
1.6 B
1.7 B
1.8 C
1.9 A
1.10 B (10 × 1)

2.1
- The floor of the store must consist of concrete or two layers of dry bricks over well-consolidated earth
- The cement bag stacks must be placed at least 600 mm from the exterior walls
- The cement bag stacks must not be higher than 10 bags to prevent lumping
- If cement is stored during the rainy season, the stacks must be enclosed in plastic wrap (4 × 1)

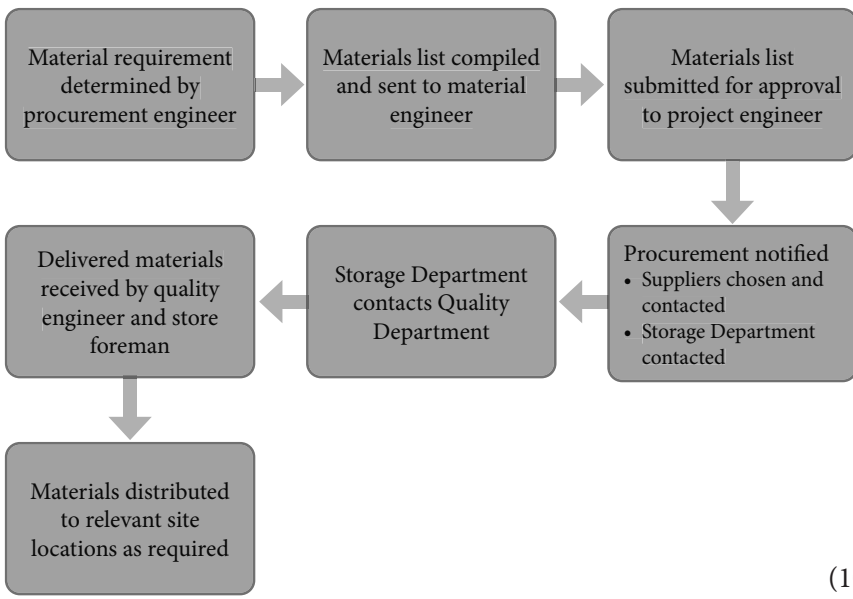
2.2 Aggregate must be stored on a hard, level and dry piece of ground. If such a space is not available, one of the following must be used to prevent contamination:

- Plank platform
- Corrugated iron sheet
- Brick floor
- Concrete floor (7)

2.3
- Higher-quality concrete is produced.
- Storage requirements for the materials are eliminated
- Wastage is limited (3 × 1)

2.4
- Coal tar
- Aluminium leaf paints
- Micro crystalline wax (3 × 1)

2.5



(10)

3.1

INVOICE

Jack's Construction Supplies

Jack's Construction Supplies
123 Mopani avenue
Lynnwood
Pretoria
086 123 8765
jack@construction.co.za

20 June 2021

INV007

Due in 30 days

BILL TO

Group 7 Developers
75 Numbers avenue
Builtfield
Johannesburg
011 555 0075
group7@developers.co.za

SITE/LOCATION

200 Frank street
The Willows
Pretoria

DESCRIPTION	QTY/HR	UNIT PRICE/RATE	TOTAL
Materials			
PPC cement	150	50	7500
Fine aggregate (m^3)	10	150	1500
Coarse aggregate (m^3)	10	200	2000
Remarks/Payment instructions		SUBTOTAL	11000
		DISCOUNT	0
FNB CHEQUE ACC 123 456 789 Ref: Name and Invoice number		SUBTOTAL LESS DISCOUNT	11000
		TOTAL RATE	15%
		TOTAL TAX	1650
		BALANCE DUE	**R 12650**

(23)

Total: 60 marks

Module summary

In this module, students learnt the following:

- The material flow process consists of:
  - procurement;
  - storage; and
  - use.
- Procurement is the process where the required building materials are obtained
- The procurement process consists of the following:
  - material selection;
  - ordering;
  - delivery.
- The selection of suppliers is a part of the planning phase of a project

- The criteria for selecting a supplier include being able to deliver the required material at the correct time, within the required specifications and at the best possible price
- The procurement engineer compiles a materials list using the information from:
  - plan drawings;
  - the bill of quantities;
  - contract specifications; and
  - the scope of works.
- The materials list is submitted for approval by the materials engineer and the project engineer
- The Procurement Department notifies the suppliers and places an order with them
- The Procurement Department also contacts the Storage Department to notify them of the delivery, which in turn notifies the Quality Department.
- Delivered material is received and inspected by the store foreman and the quality engineer, checking that:
  - the delivered material matches the approved material request; and
  - the material is stored correctly.
- Stored material is then distributed to the relevant locations on site where it is used
- There are two types of stores: one for operating inventory and the other for building materials
- Operating inventory includes tools and consumable inventory
- The storage guidelines of commonly used building materials are as follows:
  - bricks:
    - bricks must be stacked according to type, size, strength and type of material; and
    - brick stacks must be stored on firm ground with a stack being 50 bricks long, 10 bricks high and four bricks wide.
  - steel
    - steel reinforcement must be stored according to size, class and length;
    - steel reinforcement bars must be coated with cement wash and their tips must be painted;
    - steel reinforcement stacks must be lifted 150 mm above ground level;

    - structural steel must be stored according to size, class and length;
    - structural steel must be stored on a platform or any other suitable support structure, 150 mm above ground level to prevent distortion;
    - for long-term storage or storage in coastal areas, the steel members must be coated with a primer to prevent rust and scaling.
  - cement
    - cement must be stored in a building that is as dry as possible without many windows;
    - the floor must be covered with bricks or concrete;
    - different types of cement must be stacked separately;
    - the stacks must be placed on a platform 150 mm above ground level and 600 mm from exterior walls;
    - the cement bags must be tightly stacked, in alternate directions, no higher than 10 bags and no wider than four bags;
    - cement must be stacked so that the FIFO principle can be applied.
    - stacks must be dated; and
    - stacks must be enclosed in plastic during the rainy season.
  - aggregate
    - aggregate must be stored on a hard, level and dry piece of ground or on a plank platform, corrugated iron sheet, brick floor or concrete floor to prevent contamination;
    - fine and coarse aggregate must not be allowed to mix; and
    - fine aggregate must be stacked in a location where wind losses can be kept to a minimum.
  - timber
    - timber must be stored at least 150 mm above ground level on treated ground beams, sleepers or brick pillars;
    - different wood types and lengths must be stored separately;
    - stacks should have a height and width of 1,5 to 2 m, with the distance between the stacks being at least 450 mm;
    - stacks must be protected from direct sunlight, dry winds and rain and must be stacked on a flat surface to avoid warping; and
    - for long-term storage, the ends of all members must be coated with coal tar, aluminium leaf paints or micro crystalline wax.
- Large projects normally use a concrete plant or batching plant, where the materials at the batching plant are normally stored in bins

- The use of a batching plant provides the following benefits:
  - higher-quality concrete is produced;
  - storage requirements for the materials are eliminated; and
  - wastage is limited.
- The different forms used in the procurement process include the following:
  - requisition form: An internal document used to request materials;
  - order form or purchase order: Used to place an order at the company that supplies the requested material;
  - invoice: A form that is sent to the customer once an order has been accepted, demanding payment;
  - receipt: A form that is issued when an invoice has been paid; and
  - delivery note: A form that is issued when the material is physically delivered.
- One of the biggest problems facing the construction industry today is material wastage
- Reducing wastage may lead to an increase in profits and may make the firm more competitive in obtaining business contracts
- Waste management aims to control and limit the amount of material waste during construction activities
- Sources of construction waste include the following:
  - altered designs;
  - procurement activities;
  - material handling; and
  - construction works.
- The following measures can help to reduce the waste of materials on site:
  - planning ahead;
  - deconstructing instead of demolition;
  - proper handling;
  - reducing errors; and
  - new technologies.

6 Construction equipment

By the end of this module, you should be able to:

- describe the components and uses of scaffolding as well as the various types:
  - independent scaffolding
  - cantilever scaffolding
  - mobile scaffolding;
  - putlog scaffolding
  - hanging scaffolding
- explain the factors to inspect in establishing the safety of scaffolding;
  - erection
  - anchoring to structures
  - sturdiness
  - platforms; and
- identify the following construction equipment types and their uses:
  - hoisting equipment
  - levelling equipment
  - concrete mixing equipment
  - hand and power tools.
  - excavation equipment
  - compacting equipment
  - transporting equipment

If you close your eyes and imagine a construction site, what do you see? Workers with hardhats and overalls? The previous modules discussed construction from a management point of view, only mentioning equipment in terms of security, safety and storage. As there can be no construction works without building materials, so too will the building materials be useless without construction equipment. The builders of the Great Pyramid of Giza used some form of tools and equipment and a workforce of thousands of skilled tradesmen and it still took 20 years to construct.

Exercise 6.1

SB page 146

1.1 True

1.2 False. Scaffold ties are used to tie the scaffold structure to the building that is being worked on

1.3 False. Base plates are the components of a scaffold that help to distribute the weight of the scaffold over the ground

1.4 True

1.5 False. The components that are positioned between two parallel ledgers are called transoms (5 × 2)

2.
- Cuplock: This is one of the most popular sub-types due to its quick and easy assembly, which is achieved by the cuplock connection system. The vertical components have fixed bottom cuplocks into which the flanged horizontal components slide. The top flange is then secured with the loose top cuplock, which keeps it in place. The components are made from galvanised steel and can carry heavy loads
- Kwikstage: Kwikstage is a popular type in the UK and Australia. It has a unique connection that makes it quick and easy to assemble. The vertical and horizontal components have rings welded to them and are then connected using a wedge or pin that slides through both rings (2 × 3)

3.1 Mast climbing scaffold: This type of scaffold can move up and down by using the vertical components as a track. It is powered by electric motors, supports heavy loads and can climb several floors high (2)

3.2 Suspended scaffold: This type of scaffold is suspended from a cable system instead of being built from the ground up. It is commonly used for small projects such as maintenance of very tall structures (2)

Total: 20 marks

Exercise 6.2

SB page 164

1.1 winch
1.2 derrick crane
1.3 backhoe
1.4 grader
1.5 elephant's foot roller
1.6 hack
1.7 ratchet
1.8 bolster
1.9 cordless drill
1.10 angle grinder (10 × 1)

2. A: Mast
B: Short jib
C: Counterweight
D: Long jib
E: Operator's cab (5 × 1)

3.
- Round file
- Half-round file
- Hand file (3 × 1)

4.
- Chipping hammer: It is used to remove welding slag and spatter from welds
- Bobbejaan spanner: It is used to tighten or loosen threaded pipes and pipe fittings (2 × 1)

5.
- Drum mixers: Drum mixers use a rotating drum that has a double conical frustum shape. There are three sub-types of drum mixers:
  - Tilting drum mixer: after the mixing process is complete, the drum can be manually tilted to eject the concrete contents;
  - Non-tilting drum mixer: this drum rotates on a horizontal axis and is open on both sides: one side is used for feeding material and the other for discharging via a chute; and
  - Reversing drum mixer: like the non-tilting drum, it is also open on both sides, but has two sets of blades inside the drum. The one set is used for mixing and the other for discharging. Rotation of the drum is reversed to switch between mixing and discharging.
- Pan mixer: This type of mixer uses a cylindrical pan instead of a drum. Like the other mixers, it also has sets of blades to ensure proper mixing. In some models it is the pan that rotates, while in others the blade sets rotate (5 × 2)

Total: 30 marks

Pair activity 3: Model building

SB page 166

Resources needed

- Approximately 30 ice cream sticks with and/or without grooves per student OR
- Thin wooden dowels cut to lengths of 10 cm
- Small rubber bands
- One small plastic bag per student
- Marbles/small stones
- A scale that can measure small weights

Instructions

Before giving the students this task, you must build your own scaffold to see what works and what does not work.

You can order or buy ice cream sticks from most shops that have a stationary section (e.g., Crazy Store, arts and crafts shops, Pick n Pay, partyware shops, Makro, etc.)

You can also use wooden dowels and have them cut into lengths of approximately 10 cm. Dowels are mostly available in hardware stores, arts and craft shops, etc.

- Divide the class into pairs
- Explain to the students that they must build a scaffold and add weight to it until it collapses. The main purpose of this exercise is that students can understand how a scaffold works
    1. Discuss what the best design would be.
    2. Build a scaffold that is approximately 20 cm high.
    3. Put marbles or small stones into a plastic bag and close the bag so that the marbles or stones cannot fall out.
    4. Place it on the scaffold.
    5. Repeat the process by adding more marbles/stones into the bag until the scaffold collapses.
    6. Weigh the bag to determine at what weight your scaffold became unsafe.

Summative assessment

SB page 171

1.1. B
1.2. C
1.3. C
1.4. B
1.5. D
1.6. A
1.7. C
1.8. D
1.9. B
1.10. C (10 × 1)

2.1 Any reasonable description:

A: Transverse brace: Braces are components that add structural rigidity and stability

B: Scaffold boards: These create the bay, providing a platform for workers from which to work

C: Toe board: This prevents tools and debris from falling off

D: Transoms: These are the horizontal cross sections that run between ledgers, thereby creating structural stability

E: Ledger: This is the horizontal cross sections of the frame that run between standards

F: Standards: These are the vertical or upright components to which all the horizontal components are connected

G: Base plate: It connects to the standard at ground level and helps to distribute the weight of the structure (7 × 2)

2.2
- Cross braces: These braces are positioned on the sides of the scaffold. The brace runs diagonally between an inside ledger and an outside standard ledger or diagonally between ledgers. Cross braces are put at every other level
- Sway braces: These braces prevent the scaffold from swaying. They are positioned on the front face of the scaffold structure running the length of the frame diagonally. Sway braces are put on the first and last level as well as every fourth level in-between (8)

2.3
- Cuplock: The vertical components have fixed bottom cuplocks into which the flanged horizontal components slide. The top flange is secured with the loose top cuplock, which keeps it in place
- Kwikstage: The vertical and horizontal components have rings welded to them and are then connected using a wedge or pin that slides through both rings (2 × 2)

2.4.1 Beams: Beams are used as crossing spaces between scaffold structures where the scaffold cannot be erected

2.4.2 Lighting: Lights are installed to enable workers to continue their work during poor light conditions or at night (1 × 2)

3.1 The most common transport equipment used on a construction site is trucks. The different types of trucks used include the following:
- Dump trucks are used to deliver raw materials or remove rubble and waste from the site
- Flatbed trucks are used to transport equipment and material that is not damaged by rain
- Tankers are used to transport any fluids such as:

  - fuel for machinery;
  - wastewater from the site; and
  - water used for spraying dirt roads to reduce dust.
- Concrete trucks are used to deliver concrete that is mixed while being transported to the site (4 × 2)

3.2.1 Crowbar
3.2.2 Level
3.2.3 Round file
3.2.4 Chisel
3.2.5 Welding machine
3.2.6 Cordless drill (6 × 1)

3.3 Compacting the soil is important, as it decreases the chances of settlement after the structure has been built. If this is not done, it could lead to premature failure of the road or building and consequently high repair and maintenance costs.
- Light soil compaction equipment includes the following:
  - rammer: a rammer is a hand-steered piece of equipment that is operated by one person. It is ideal for compacting soils such as clay located in tight spaces, e.g. trenches and building foundations;
  - vibratory tampers: these machines have a base plate installed on vibratory tampers that are spring-activated and driven by a motor. Instead of using impact to compact, like the rammer, it uses vibrations. They have a larger operational surface than rammers and can weigh between 50 kg and 100 kg; and
  - vibratory plate compactors: a larger version of the vibratory tamper, it can weigh between 100 kg and 2 tons. It is used to compact soils such as sand using vibration. (8)

Total: 60 marks

Module summary

In this module, students learnt the following:

- Scaffolding or a scaffold is a temporary structure that is built to provide workers with a platform when working at heights
- The different components that make up a scaffold structure are as follows:
  - standards;
  - ledgers;
  - transoms;
  - base plates;

  - braces;
  - couplers;
  - scaffold ties; and
  - scaffold boards.
- Extra scaffold components that are added as required by the specific project may include the following:
  - stairways units;
  - beams;
  - rubbish chutes;
  - netting; and
  - lighting.
- The main types of scaffold used around the world are as follows:
  - bamboo;
  - tube and clamp; and
  - systems:
    - cuplock; and
    - kwikstage
  - frame and brace;
  - suspended;
  - mast climbing;
  - trestle; and
  - single-pole.
- Hoisting is an activity where material is lifted against the force of gravity to move it from one location to another
- The different types of hoisting equipment used on a construction site include the following:
  - pulleys and sheaves;
  - chain hoists;
  - winches; and
  - cranes.
- The different types of cranes used on a construction site include the following:
  - mobile
  - tower; and
  - derrick.
- Excavation is the process of removing soil, rock and other materials using tools and equipment

- The machinery used for excavation on a construction site includes the following:
  - excavator;
  - backhoe; and
  - loader.
- Levelling the ground surface before starting construction helps to ensure the integrity of the foundation and the structure as a whole
- The machinery used to level construction surfaces includes the following:
  - bulldozer;
  - grader; and
  - wheel tractor scraper.
- It is important to compact the soil, as it decreases the chances of settlement after a structure has been built
- Compaction equipment can be divided into two categories, namely light and heavy soil compaction equipment
- Light soil compaction equipment includes the following:
  - rammers;
  - vibratory tampers; and
  - vibratory plate compactors.
- Heavy soil compaction equipment includes the following:
  - smooth wheel rollers;
  - sheep foot rollers; and
  - pneumatic tired rollers.
- Concrete is mixed by combining cement, aggregates and water in the correct ratio.
- Concrete mixers can be divided into two categories, namely batch mixers and continuous mixers.
- The different types of batch mixer equipment include the following:
  - Drum mixers use a rotating drum with a double conical frustum shape to mix the concrete. There are three types:
    - Tilting drum mixer
    - Non-tilting drum mixer
    - Reversing drum mixer.
  - Pan mixers use a cylindrical pan instead of a drum.
- Continuous mixers run continuously and consist of the following three main parts:
  - a feeder unit;
  - a mixer; and

  - a discharging section.
- Concrete trucks are used for mixing when the site is a sufficient distance away
- Trucks are the most common type of transport equipment used on a construction site
- Types of trucks commonly used are the following:
  - dump trucks;
  - tankers; and
  - concrete trucks.
- Hand tools are more precise than power tools.
- Power tools require electricity to work.
- Different types of hand tools used on a construction site are as follows:
  - hammers;
  - spanners and wrenches;
  - saws;
  - files;
  - screwdrivers;
  - levels;
  - measuring tapes;
  - shovels;
  - crowbars;
  - bolsters;
  - chisels;
  - floats;
  - masonry trowels;
  - pliers;
  - ladders; and
  - wheelbarrows.
- Different types of power tools used on a construction site include the following:
  - saws;
  - angle grinders;
  - vacuum cleaners and blowers;
  - jackhammers;
  - drills; and
  - welding machines.

7 Foundations

By the end of this module, you should be able to:

- analyse the use of having a good foundation, such as:
  - importance of having a good foundation
  - transferring of loads
  - differential settlement
  - problems of a weak foundation;
- draw and choose the kind of foundations suitable for various soil conditions:
  - raft foundation
  - strip foundation
  - pad foundations
  - pile foundation
  - buoyed foundations
  - cantilevered foundations; and
- describe the use of testing the soil to choose the appropriate foundation:
  - testing of soil
  - load testing.
  - soil types & properties

Before babies can learn to stand upright, they first need to strengthen their legs. Without strong legs, people in general would not be able to stand up, much less walk around. The same can be said of building foundations. Foundations are the legs of a building and without strong foundations, a building is sure to crack or even collapse at some point. One of the most famous cases of foundation failure is the Leaning Tower of Pisa. When construction started roughly 840 years ago, soil-related foundation issues were discovered, with the soil not being able to carry the weight of the structure. At its worst, the tower was leaning 5,5°. Multiple efforts of foundation repair have fortunately stabilised the tower and it now only leans 4°.

Exercise 7.1

SB page 178

1.1 Load bearing capacity
1.2 Undermining
1.3 Strong wind
1.4 Load intensity
1.5 Soil movement (5 × 1)

2.
- Cracks: Although hairline cracks in plastered walls are mostly normal and simply require a new coat of paint, large cracks in the floor and exterior walls are of great concern. These types of cracks, if ignored, may eventually cause the roof or building to collapse. Large cracks in the corners of rooms may indicate that the walls are pulling away from each other due to the foundation
- Foundation level settling: A settling foundation will slant to one side, meaning that it is unstable and going to fail. You will see cracks in the wall before noticing the slanting foundation
- Doors and window not closing properly: As a foundation moves, things like door and windows frames that have right angles are going to distort. This will cause the doors and windows to stop closing properly. Often the glass panes in the windows will start cracking due to the pressure on the frame
- Uneven floor: A moving or unstable foundation may cause the floor of the building to become uneven and have bumps. If the floor of the building is sloped, it may indicate that the supporting soil is giving way. Although the foundation might still be intact, it is a matter of time before cracks appear (4 × 2)

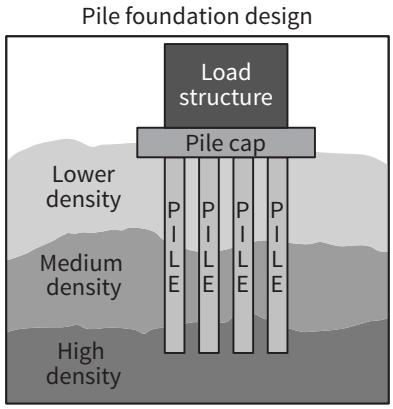
3. A foundation is built on the principle that when the area is increased, the pressure decreases. The foundation thus increases the area, thereby reducing the pressure that the structure puts on the underlying soil (2)

Total: 15 marks

Exercise 7.2 SB page 184

1.1 False. Shallow foundations are best suited for lightweight structures
1.2 False. A traditional strip foundation must at least be as deep as the width of the wall it is supporting
1.3 True
1.4 True
1.5 False. A foundation with a depth three times its breadth is called a pile foundation (5 × 2)

2.



(7)

3.
- Separated pads
- Balanced base pads
- Continuous pads
- Pad and beam (4 × 1)

4. According to load transfer and installation method (2)

5. The buoyed foundation is a foundation that is placed at depth under the surface level, so that the weight of the finished structure is equal to the weight of soil originally excavated (2)

Total: 25 marks

Exercise 7.3 SB page 194

1.1 expansive
1.2 dolomite
1.3 internal friction
1.4 probing
1.5 loam (5 × 1)

2.
- Wetting under load
- Stress changes
- Earthquakes or tremors (3 × 1)

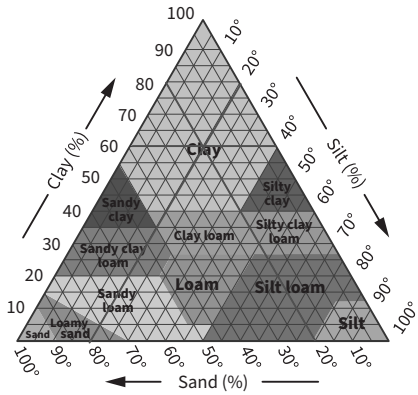
3. Sand is a coarse-grained soil consisting of mixed soil particles between 0,05 and 2 mm. Contact pressure remains parabolic on non-cohesive soil such as sand. It has good properties such as a high bearing capacity and high shear resistance. It does not retain much moisture and drains well. Moist compacted sand holds together well and maintains a high strength. After it has dried out, a large amount of pressure must be applied before it crumbles which makes it a good soil type to support a building structure.

The particles can, however, wash away over time, leaving gaps beneath the foundation that may cause settlement issues (6)

4. % Sand = $\frac{3,5}{7} \times 100 = 50\%$

   % Silt = $\frac{2}{7} \times 100 = 29\%$

   % Clay = $\frac{1,5}{7} \times 100 = 21\%$ (3 × 2)

5. 

   Clay soil (4)

6. The ultimate load on the plate (1)

Total: 25 marks

Group activity 4: Class discussion

SB page 196

If possible, show any of the following videos in class:

Video 1: House collapses in India

eLink

Students may visit this link to learn more about the collapse of a three-storey building: futman.pub/BuildingCollapse

The above video shows a 3-storey building that was still under construction, suddenly collapsing in June 2020, in India. The house was built very close to the canal, which violated the state's building regulations.

The incident was preceded by heavy rainfalls the day before as well as excavation works which were done in the nearby canal during the previous weeks. This reduced the integrity and stability of the building's foundation. Approximately two days before the incident cracks started to appear in the foundation, which proved that the stability of the structure had already started to deteriorate even before the rainfalls.

Video 2: Apartment building collapses in Florida

eLink

Students may visit this link to learn more about the collapse of an apartment building: futman.pub/ApartmentCollapse

In June 2021 an apartment building near Miami beach in Florida collapsed in the middle of the night.

The building, which had 136 apartments sat above an underground parking area extended below the common pool deck. On the night of the collapse, there was a failure of the pool deck next to the building. About seven minutes later, the building began to fall.

Although the cause of this incident cannot be linked to the foundation of the building, it seems that water leaking through the slab above the underground parking started to eat away at the reinforced columns, causing structural weaknesses. The overloading of the columns underneath the pool deck and the omission of load carrying beams, caused the pool deck to crash down on the parking garage, collapsing the building on top of it.

This video shows how important it is to make sure that each part of a building structure is designed and built to carry the correct load.

Discuss the following questions in class:

1. Why are foundations so important when building a structure?

   Possible answer: The primary purpose of a foundation is to hold the structure together. As ground is always moving slightly, without a proper foundation, the structure would quickly sink into the ground unevenly, resulting in cracks and damage to the building. The three most important functions of a foundation are to bear the load of the building, to anchor it against natural forces such as earthquakes, and to isolate it from ground moisture.

   Foundations reduce load intensity, distribute the load, provide a level surface to build upon, and provide lateral stability, protecting against undermining and soil movements (this information can be found in the textbook).

2. What might cause a foundation to fail?

   Possible answers:
   - Movement of the soil due to shrinkage when it starts to dry out during hot, dry seasons. Whenever this happens, the soil's support for the foundation can break away from the foundation, making it unstable and prone to shifting
   - Water: When the soil beneath the foundation is too wet, either from a lot of rain, rising water table, plumbing leaks, etc. it might cause problems with the foundation. When the soil is soaked with too much water, it swells and enlarges, forcing the foundation upward
   - Poor building site and ground preparation: Problems can occur if the structure is built on top of different soils, where one absorbs water well, and the other does not
   - Soil erosion as a result of bad drainage could cause the foundation to become unstable
   - Poor soil, organic components, debris, etc., may cause expansion or consolidation of the soil, which contributes to foundation failures
   - Tree roots or shrubbery close to the building could dehydrate the soil beneath the building, causing soil shrinkage and affecting the settlement of the foundation

3. What can happen if foundations are faulty or the wrong foundation is built on the wrong soil type?

   Possible answers: Cracks; sinking foundation; doors and windows not closing properly; uneven floors building collapses.

Group activity 5: Soil testing

SB page 197

Resources needed

- Straight-edged, clear jar per group of students
- Permanent marker
- Ruler
- Watch or stopwatch
- 1 Tablespoon of powdered dishwashing detergent or borax
- Mesh sieve or an old colander
- Copy of the soil triangle for each group (see next page)

Instructions

- Divide the class in small groups

- Explain the instructions given in the Student Book to the students

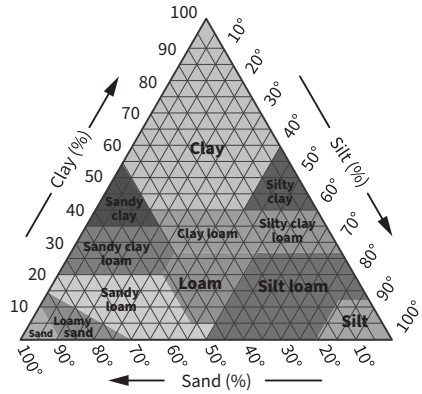
Mark each group's report as follows:

Does the report cover each of the following?

- The steps the students followed
- What they observed
- The height of the soil layers after 60 seconds, 2 hours, and after 48 hours
- The calculations the students made to determine the percentages of sand, silt, and clay
- A copy of the soil triangle with their lines drawn as per the above calculations
- The type of soil

Marks

5 = all the above was covered in detail
4 = most of the above was covered in detail
3 = some of the above was covered in some detail
2 = little of the above was covered. Detail is scarce
1 = no effort was put into the task



Soil texture triangle

Soil texture triangle

Summative assessment

SB page 199

1.1 C
1.2 B
1.3 D
1.4 A
1.5 C
1.6 D
1.7 B
1.8 D
1.9 B
1.10 A (10)

2.1 It consists of two superimposed slabs that are connected to each other via ground beams, leaving voids between the sections. This type of raft foundation is suitable for heavy loads or loose soil (3)

2.2 Load transfer piles:

- End-bearing piles – Piles of which the bearing capacity relies entirely on the underlying soil
- Friction piles – Piles of which the bearing capacity is increased due to the friction along the pile's shaft

Installation method piles:

- Driven piles – Prefabricated piles that are either driven, screwed or hammered into the ground
- Bored piles – Piles that require a bored hole in which the piles are then formed using reinforced concrete (10)

2.3 Cantilevered foundation or strap footing foundation (1)

2.4 Strap beam. Its purpose is to help to distribute the heavy load of one footing to an adjacent footing (2)

2.5 A strip foundation also called a strip footing is a foundation type that provide a continuous strip of support to walls that are built directly on top of it (2)

3.1 The plate load test is used to determine the full bearing capacity of the ground as well as the likelihood of settlement when subjected to a load (2)

3.2 A: Test plate or plate block
B: Dial gauge fixture
C: Dial gauge
D: Ball and socket arrangement
E: Loaded platform

F: Head room for observer of dial gauge
G: Pit strutted if necessary
H: Jack (8 × 1)

3.3
- Possible misleading results if the soil properties change at shallow depths
- Its duration is short and therefore does not provide ultimate settlements for cohesive soils
- Due to the bearing capacity of dense sandy soils to increase as the size of the foundation increases, the small plate used for the test provides conservative values (3 × 1)

3.4 Settlement of the foundation = settlement of plate $\times \frac{\text{width of pit}}{\text{size of plate}}$ (2)

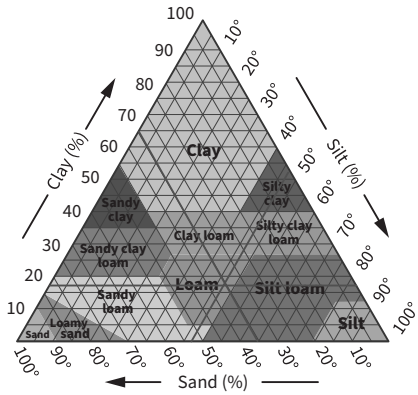
3.5.1 % Sand = $\frac{4}{11} \times 100 = 36\%$

% Silt = $\frac{5}{11} \times 100 = 46\%$

% Clay = $\frac{2}{11} \times 100 = 18\%$ (3 × 2)

3.5.2 Silt (1)

3.5.3



Loam soil (4)

3.5.4 Properties of loam soil:
- Cohesion: Strong particle cohesiveness; highly plastic and mouldable, particularly when wet
- Internal friction: There is very little friction between the small particles. Shear failure under the strain of a building can result in heaving soil due to its flexibility
- Permeability: Water drains slowly and soil consolidates slowly due to limited permeability (6)

Total: 60 marks

Module summary

In this module, students learnt the following:

- Foundations fulfil the following functions:
  - reducing load intensity on the soil;
  - distributing the load of the structure;
  - providing a level surface to build on;
  - providing lateral stability;
  - protecting the structure against undermining; and
  - protecting the structure against soil movements.
- A weak foundation is one that shifts easily
- Signs of a week foundation include:
  - cracks;
  - foundation level settling;
  - doors and windows not closing properly; and
  - uneven floors.
- Foundations can be divided into two main groups:
  - shallow foundations; and
  - deep foundations.
- Shallow foundations have a depth of less than 3 m and are easier and quicker to construct
- Different types of shallow foundations include the following:
  - strip foundations, consisting of the following sub-types:
    - traditional; and
    - deep.
  - pad foundations, consisting of the following different arrangements:
    - separated pads;
    - balanced pads;
    - continuous pads; and
    - pads and beam.
  - raft foundations, consisting of the following sub-types:
    - solid slab raft foundations:
      - flat mat raft;
      - wide toe raft;
      - slip plane raft;
      - blanket raft; and
      - slab beam raft foundations.
    - cellular raft foundations; and

        - piled raft foundations.
- Different types of deep foundations include the following:
    - pile foundations, which are classified as according to the following:
        - load transfer method
            - end-bearing piles; and
            - friction piles.
        - installation method
            - driven piles; and
            - bored piles.
    - buoyed foundations; and
    - cantilevered foundations.
- Soil conditions determine the type of foundation to be constructed
- Soils can be divided into three main groups:
    - expansive soils;
    - collapsible soils; and
    - erodible soils.
- Main soil types include:
    - clay;
    - sand; and
    - loam.
- Soil is analysed based on the following properties:
    - compressibility;
    - cohesion;
    - internal friction; and
    - permeability.
- Methods to obtain a soil sample are:
    - test pits;
    - probing; and
    - boring.
- Once a soil sample is obtained, it can be classified by means of a soil jar test
- The plate load test is used to determine the soil's load-bearing capacity
- The plate load test has the following limitations:
    - it may produce misleading results if the soil properties change at shallow depths;
    - its duration is short and therefore it does not provide ultimate settlements for cohesive soils; and
    - due to its method, the test provides conservative values.

8 Organisations in the construction industry

By the end of this module, students should be able to:

- differentiate between different types of organisations in the construction industry and discuss the structure and advantages and disadvantages of each; and
- discuss mistakes in the business environment.

If you have driven past large construction sites in the past, at some stage you probably saw signage showing that it is a Murray & Roberts project. Murray & Roberts have been in the construction industry for well over 100 years and is one of the top five construction companies in South Africa. They were involved in projects such as Newland's Stadium, the Gautrain infrastructure and Palm Islands projects in Dubai. In 2017 their Southern African infrastructure and construction businesses were acquired by a holding company called the Southern Palace Group and rebranded as Concor. In this module you will learn about the various types of organisations, their structures, their advantages and disadvantages as well as mistakes made in the construction industry.

Exercise 8.1

SB page 211

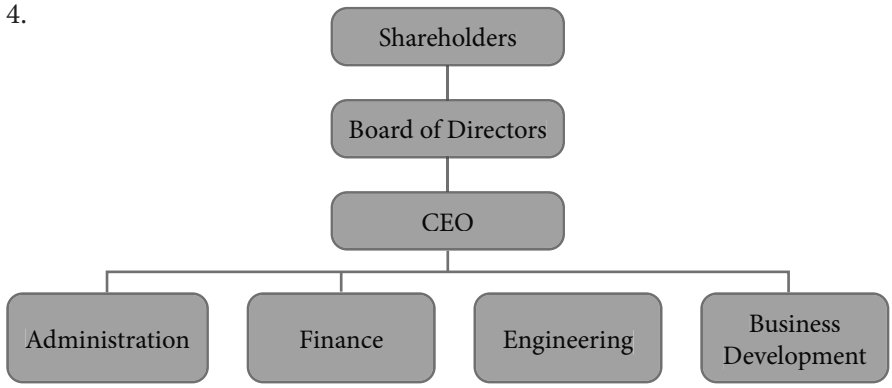
1. 1.1 C; 1.2 E; 1.3 A; 1.4 B; 1.5 D (5 × 1)

2.
   - The legal liability of the owners for the management of the organisation
   - The legal liability for the debts of the organisation (2 × 1)

3.1 A sole practitioner is normally a professional who sells a service to clients, e.g. an architect or an engineer (2)

3.2 A holding company is a parent company that has subsidiary companies that compete in related markets (2)

4.



(5)

5. Any two of the following:

Advantages:

- It is the easiest and cheapest business type to set up and dissolve
- The owner makes all the decisions
- All the profit goes to the owner
- Fewer regulations apply to it
- There are no corporate income taxes, as all income is considered the owner's personal income

Disadvantages:

- The owner is liable for all business obligations
- Raising capital may be difficult, as it sources from the owner's savings or loans

(4 × 1)

Total: 20 marks

Group activity 6: Knowledge quiz

SB page 211

You will need:

- Pen/pencil and paper for each group member
- Something to identify each group by (e.g., different coloured rosettes, small flags/streamers from crinkle paper, different hats, plastic noses, moustaches, etc.). The purpose for this is simply to make the students feel part of their groups and to add some fun to the game. It is, however, not compulsory
- Timer: The lecturer will allocate one minute to answer each question
- A prize for the winning group or each member of the group. It does not need to be something big, for example, a cake for the winning group to share, a chocolate for each member, a big chocolate to share, a new pencil for each member, etc.
- Print-out of the questions and memoranda

Instructions

- Follow the instructions as given in the Student Book

Questions

The students do not have to write the answers out in full sentences, as long as the meaning of their answer will be understood by the person marking it.

1. Explain the legal entity which you are a member of.
2. List TWO advantages of the entity
3. List TWO disadvantages of the entity

MEMORANDUM FOR THE KNOWLEDGE QUIZ

	Sole trader	Partnership	Company	Holding company
1. Explain entity	One person; owner	Two or more people	Group of people	Parent company with subsidiary companies
2. Advantages	Easiest and cheapest to set up and dissolve	Easy to set up	Ownership indicated by shares	Easy to set up
	Owner makes all the decisions	Easier to get money	Relatively easy to transfer ownership	Owns the assets
	All profit goes to the owner	No corporate taxes	Shareholder can be employed	Tax benefits
	Fewer regulations	Motivate employees to become partners	Easier to get money	Discount on supplies due to bulk purchasing
	No corporate income taxes		Access to a wide set skills base	Hold a competitive edge over other companies
				Favourable for investors – easier to earn money
				Limited risks. Cannot be held accountable for a subsidiaries' debt

	Sole trader	Partnership	Company	Holding company
3. Disadvantages	Owner is liable	Partners are jointly liable	Expensive to set up and maintain	Very expensive to set up
	Difficult to get money	All decisions must be made jointly	Complicated financial reporting	May cause management challenges
		Disputes may arise	Directors can be held liable for debts	Speculative activities
			Profits are subjected to corporate taxes	Not easy to sell shares
				Reduces transparency

Summative assessment

SB page 215

1. Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in your workbook.

1.1. C
1.2. B
1.3. A
1.4. D
1.5. C
1.6. D
1.7. A
1.8. B
1.9. C
1.10. A (10 × 1)

2.1
- Private limited company: These companies are usually smaller than the public limited types. The shares are not sold to the general public and the company must meet certain requirements. Usually, the shareholders are part of a family group or shares are sold by agreement between existing shareholders. The financial reporting requirements are only for taxation purposes, with the financial records only available to its shareholders.
- Public limited company: Public limited companies (PLCs) are larger than limited companies. Their shares are traded on the various stock exchanges. Any person can buy company shares,

with the price being very reliant on events occurring within the company or in the specific market in which it competes. A PLC can issue additional shares to raise capital, but is subject to stricter regulations than private companies. The financial reporting requirements are vaster, as the financial records are available to the public. (2 × 4)

2.2 Any four of the following:

Advantages:

- The liability of the shareholders is limited
- It is relatively easy to transfer ownership by selling shares to another party
- Shareholders can be employed in the company
- Access to capital is larger
- It offers access to a wider skills base.

Disadvantages:

- It is relatively expensive to set up and maintain
- The financial reporting requirements are complex
- If directors fail to meet their obligations, they may be held personally liable for the company's debts
- The profits are subject to corporate taxes. (2 × 4)

2.3 Strategic mistakes:

- The owner of a sole trader might accept a project that is too big to handle
- A holding company invests in a business that has severe financial problems

Operational mistakes:

- Procuring low-quality building materials at a very good price
- Setting policies and procedures in place that do not account for site safety (2 × 2)

Total: 30 marks

Module summary

In this module, students learnt the following:

- A legal entity is defined as an organisation or company that is treated by the law as a person, being able to enter into contracts and to be sued
- The two main types of legal entities are classified according to:
  - the legal liability of the owners for the management of the organisation; and

  - the legal liability for the debts of the organisation.
- The managers of an organisation have a responsibility to report to the stakeholders regarding the organisation's operations and financial health
- The different types of legal entities in the construction industry are the following:
  - sole traders;
  - partnerships;
  - companies; and
  - conglomerates or holding companies.
- A sole trader is a legal entity that consists of one liable person, who is also the owner of the business
- The business equity and liability are the owner's responsibility
- The two types of sole traders are as follows:
  - sole proprietor; and
  - sole practitioner.
- The advantages of a sole trader:
  - it is the easiest and cheapest business type to set up and dissolve;
  - the owner makes all the decisions;
  - all the profit goes to the owner;
  - fewer regulations apply to it; and
  - there are no corporate income taxes, as all income is considered the owner's personal income.
- The disadvantages of a sole trader:
  - the owner is liable for all business obligations; and
  - raising capital may be difficult, as it sources from the owner's savings or loans.
- A partnership consists of two or more people who share the equity and are jointly and separately liable for the business debt
- The different types of partnerships are the following:
  - general partners;
  - limited partners; and
  - nominal partners.
- The advantages of a partnership:
  - it is relatively easy to set up, although considerable time is spent on the development of the partnership agreement;
  - it is easier to raise capital compared to a sole trader;
  - there are no corporate taxes, as all income is considered the partners'

personal income; and
  - the business may motivate employees to become partners.
- The disadvantages of a partnership:
  - partners are jointly liable for all business obligations and
  - all decisions have to be made jointly by the partners, which may lead to disputes, especially if there are only two partners.
- Companies are businesses that are owned by a group of people, many of whom do not participate in the management of the business.
- The two main types of companies are the following:
  - unlimited companies; and
  - limited companies.
- The two types of limited companies are as follows:
  - private limited company; and
  - public limited company.
- The general advantages of a company:
  - the liability of the shareholders is limited;
  - it is relatively easy to transfer ownership by selling shares to another party;
  - shareholders can be employed at the company;
  - access to capital is larger; and
  - it offers access to a wide skills base.
- The general disadvantages of a company:
  - it is relatively expensive to set up and maintain;
  - the financial reporting requirements are complex;
  - if directors fail to meet their obligations, they may be held personally liable for the company's debts; and
  - the profits are subject to corporate taxes.
- A holding company is a parent company that has subsidiary companies that compete in related markets
- A holding company has a separate identity from its subsidiaries, but is liable for the debts that it incurs
- A conglomerate is a parent company with subsidiaries that compete and trade in unrelated markets
- The parent company has a separate legal identity, but is liable for the subsidiary debt
- The general advantages of a holding company or conglomerate:
  - risk to the holding company is limited, as it cannot be held responsible for the liabilities of the operating companies;

  - the holding company owns the assets, which keep it safe in case of operating company insolvency;
  - there are tax benefits for holding companies situated in low corporate tax countries, thereby helping the operating companies to lower their overall tax;
  - supplies that are used by multiple operating companies can lead to big discounts and favourable credit terms, as supplies are bought in bulk;
  - holding companies provide a competitive edge to operating companies via resources;
  - it is more favourable to investors, as they are able to invest in the company of their choice; and
  - it is relatively easy to form, as shares only need to be bought in the relevant companies.
- The general disadvantages of a holding company or conglomerate:
  - it reduces transparency, as the holding company does not report on the internal management and operation of companies;
  - management challenges might arise, as holding companies seek to influence the policies and decisions of operating companies;
  - it may lead to speculative activities due to holding companies using critical information of operating companies to their favour;
  - a price monopoly might be created if a holding company keeps on acquiring operating companies;
  - it is not easy to sell shares, which might lead to losses if the holding company is forced to keep the shares; and
  - it requires massive capital investment to set up, along with experience in industry and investing experience.
- Mistakes made in the business environment may have detrimental effects on the organisation
- Strategic mistakes are mistakes made by the top management, whether it be as the owner of a sole trader or the CEO of a company
- Operational mistakes refer to decisions made at an operational level that influence the day-to-day activities as well as the company as a whole
- Poor cash flow management during a project is a common mistake made by being passive in collecting payments or not planning for contingencies.

Glossary

A

annotation – a note added by way of comment or explanation

audited – to conduct an official financial inspection of a company or its accounts

B

backward pass – the method used to calculate the latest time that activities can start and finish without breaking a schedule constraint or causing the project to be late

batch – a quantity of materials produced at one time

bill of quantities – a detailed statement of work, prices, dimensions and other details for the erection of a building by contract

bill of quantities – a document that presents the details of the project in a standardised format or order using prescribed units; it covers all the labour and materials needed during the project and the conditions under which the work must be done

brace – something that adds strength or support

C

cohesion – the sticking together of particles of the same substance

cohesive soil – fine-grained, low-strength and easily deformable soils with particles that tend to stick together

concave – a surface that curves inwards

conical frustum – the portion of a cone that remains after its upper part has been cut off by a plane parallel to its base

consolidation settlement – a time-dependent settlement that results from the gradual reduction of saturated soils because of the water being squeezed out from the pores

contact pressure – the actual pressure transmitted from the foundation to the soil

contingency – a provision for a possible event or circumstance

contingency cost – an amount of money included to cover potential events that are not specifically accounted for

contract administrator – a person appointed by the client to manage, negotiate, support and execute the contract process

convention – a general agreement regarding basic principles or procedures

cost estimate – an approximate prediction of how much money is needed to complete a project or part of a project

crawler – a vehicle (such as a crane) that travels on endless chain belts

critical path method – a technique that requires mapping out of every key task that is necessary to complete a project

D

dagha – a term that is used on South African building sites; refers to building mortar (cement) that is used for laying bricks and plastering walls and floors

demarcated walkways – when walkways have lines, markings and safety signs to show the limits, boundaries and safety regulations that pedestrians must follow

digital media – any form of media that use electronic devices for distribution

dispute – a disagreement or argument between two parties over a certain issue

D

endorsement – a public declaration of support for a person, product or service

equity – the amount of cash required to get the project up and running

F

feasibility report – a document stating whether a project can be successfully completed taking all the relevant factors, such as the economic, technical, legal and scheduling considerations, into account

final payment certificate – a certificate showing the final contract value of all the work done up to final completion of the project

float – the amount of time a given task can take without having an effect on the activities that follow

forward pass – a technique to move forward through the network diagram to determine the duration of the project and find the critical path of the project

G

galvanised steel – a type of steel that has been coated with zinc so that it can be protected from corrosion and rust

GPS – global positioning system; a satellite navigation system used to determine the ground position of an object

gully – a trench created by running water

H

hopper – a container that typically tapers downward and discharges its contents at the bottom

HVAC – heating, ventilation and air conditioning

hydraulic – a system that functions and performs tasks by using a fluid that is pressurised

I

immediate settlement – takes place at the same time the load is applied or within approximately seven days

integrity – the ability of a structure, such as a foundation, to withstand its intended load without failing because of cracks, deformation or weakness

interim payment certificate – a certificate issued to the client that approves an intermediate payment to the contractor based on the work done

J

jib crane – a crane with a pendant-supported extension attached to the boom or fly head; used to handle specific loads

lateral force – the force that acts in the direction parallel to the ground and perpendicular to the direction of the gravitational pull of the earth

legal liability – responsible or answerable by law

liable person – a person who has a legally bound obligation to pay debts or fulfil other obligations

longevity – long life, existence or service

N

non-cohesive soil – soil in which the grains remain separate from one another and do not form clods or hold together in aggregates of particles

O

organic matter – plant and animal material that is in the process of decomposing

P

permeable – water can pass rapidly through the pores

pitfall – a problem that is likely to happen in a particular situation

pneumatic – containing or operated by air or gas under pressure

principal agent – a person appointed by the client to represent him/her on site and look after his/her best interests

protrusion – something that sticks out from a surface

R

reputable – having a good reputation

reputation – the opinions that people have of someone or something

rigidity – something that cannot be bent or forced out of shape

ripper claw – the extended attachment at the rear of the bulldozer that resembles a claw

rusting – the formation of a reddish-brown substance on iron or iron objects due to oxidation

S

SACAP – The South African Council for the Architectural Profession

seating load – the initial load

secondary settlement – also called creep; occurs under constant effective stress due to the continuous rearrangement of the clay particles into a more stable configuration

settlement – the downward movement of the soil when a load is applied to it or the downward vertical movement of a foundation under load

share – a percentage of ownership in a company or a financial asset

shear resistance – the resistance against the force that pushes one part of the surface in one direction, while another part of the surface is pushed in the opposite direction

sheave – a grooved wheel used for holding a belt, wire rope or roped, and incorporated into a pulley to redirect a cable or rope, lift loads and transmit power

sheave – the rotating, grooved wheel inside the pulley

silt soil – made up of rock and mineral particles that are larger than clay, but smaller than sand

sleeper – high-quality timber

slewing unit – the upper part (of a crane) that rotates relative to the bottom part around an axis that is normally vertical

snowball – increasing rapidly in size, intensity or importance

static compression – a downward force applied by the machine on the soil surface, compressing the soil

subsidiary – an independent company of which more than 50% is owned by another firm

subsurface water – water found below the ground surface, including soil water above the water table and groundwater below the water table

surface water – water that collects on the surface of the ground

suspend – to hang from something

T

technical auditing – an on-site evaluation of deficiencies or areas of improvement in a construction process, system or proposal

trestle – a braced frame serving as a support

U

utility lines – the pipes, cables or other linear conveyance systems used to transport power, water, gas, oil, wastewater or similar items

V

variation cost – a change of work that will change the contract amount

vegetation – a general term for the plant life of an area

vetted – investigated

W

warp – becoming bent or twisted out of shape