N5
Building Administration
Lecturer Guide

Sparrow Consulting
in collaboration with Marc Pellencin

Additional resource material for this title includes:

- PowerPoint presentation
- Past exam papers
- Electronic Lecturer Guide

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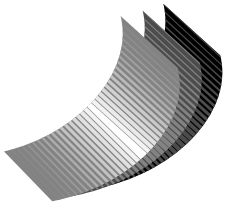
ISBN 978-1-77637-213-3

First published 2022

Acknowledgements
Sparrow Consulting would like to thank author Marc Pellencin for their contributions to this book.



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Published by
Future Managers (Pty) Ltd
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CONTENTS

Lecturer guidance

1. General aims

To develop the student's ability to manage construction sites with a good understanding of industry regulations, 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 have a National N4 Certificate with civil engineering subjects.

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 in a ratio of 40:60 to derive the promotion mark. The learner must obtain at least 40% in 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 N5 (Engineering Studies – Report 191) will be conducted as follows:
Modules 1 to 8
MARKS: 100
DURATION: 3 HOURS
This is a closed-book examination.

5.3 Weighting
The following weightings are consequently awarded to each category:

Knowledge and Understanding	Application	Analysing / Syntheses and Evaluating
25 – 35	35 – 45	20 – 30

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 the practical environment.

7. Mark allocation and weighted value of modules

MODULES	WEIGHTING (%)
1. Earnings and expenditure	10
2. Main contractors and subcontractors	10
3. Site meetings and records	10
4. Mechanical plants	15
5. Support to structures	10
6. Mass haul diagrams	20
7. Variations, omissions and handover	10
8. Statutory bodies	15
TOTAL	**100**

8. Work schedule

Week	Topic	Content	Hours
1	**Module 1** Earnings and expenditure	1.1 Earnings 1.2 Expenditure	10 hours
2	**Module 2** Main contractors and subcontractors	2.1 Pre-tender responsibilities 2.2 Contractor responsibilities 2.3 Subcontractor responsibilities	10 hours
3–4	**Module 3** Site meetings and records	3.1 Site meetings 3.2 Site records	10 hours
4–5	**Module 4** Mechanical plants	4.1 Plants and cranes 4.2 Selection of plants and equipment 4.3 Maintenance	15 hours
5–6	**Module 5** Support to structures	5.1 Excavations 5.2 Shoring 5.3 Underpinning	10 hours
7–8	**Module 6** Mass haul diagrams	6.1 Cut and fill 6.2 Mass haul diagrams 6.3 Accumulated volume	20 hours
9	**Module 7** Variations, omissions and handover	7.1 Variations 7.2 Handing over	10 hours
10	**Module 8** Statutory bodies	8.1 Building regulations 8.2 Statutory bodies 8.3 Government acts	15 hours
TOTAL			**100 hours**

9. Lesson plan template

CAMPUS	
LECTURER	
SUBJECT AND LEVEL	N5 Building Administration
PRESCRIBED TEXTBOOK: TITLE AND AUTHOR	*N5 Building Administration* by Sparrow Consulting

LESSON	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 TASK) TO BE DONE THIS WEEK
WEEK 1			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

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WEEK 2			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

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WEEK 3			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

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WEEK 4			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

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WEEK 5			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

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WEEK 6			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

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WEEK 7			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

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WEEK 8			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

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WEEK 9			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

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WEEK 10			Lecture		White board/ OHP		
			Group work		Models		
			Demonstration		Handouts		
			Simulation		Multimedia		
			INTRODUCTION TO LESSONS				
			RECAPPING/REINFORCEMENT				

MODULE

1 *Earnings and expenditure*

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

- explain the income resources of a contractor, which include:
  - preliminaries
  - measured works
  - day works
  - nominated materials; and
- explain the various expenditures of a contract, which include:
  - site overheads
  - materials
  - plants
  - labour
  - extras
  - subcontractors.

Every business sells something; either a service or a product. To offer the service or product, money is usually spent and when the service or product is sold money is received. The amount of money flowing in and out of the company is called cash flow. Proper management of cash flow is very important as you will be expected to pay for expenses while at times still waiting for your earnings. If you do not have enough cash on hand, it can result in your business closing down. In fact, lack of cash is one of the main reasons that small businesses fail. In this module, you will learn about the different sources of earnings in construction, as well as the major expenses related to typical construction projects.

Exercise 1.1 SB page 9

1.1 Preliminaries
1.2 Site office
1.3 Measured works
1.4 Day works
1.5 Plastic
1.6 Hand and power tools
1.7 Earth moving equipment

1.8 Glass
1.9 Construction vehicle
1.10 Copper (10 x 1)

2. Bills of quantities (BoQ) and schedule of rates (SoR) (2)

3. – Health and safety equipment for all personnel on site
   – Signage
   – Site layout
   – Soil and asbestos testing
   – Site security
   – Portable toilets
   – Tool and plant hire (7)

4. Any ONE of the following or any other relevant examples: (1)
   – Window glazing breaking
   – Unwanted ground conditions discovered

Total: 20 marks

Summative assessment SB page 12

1.1 C. Levelling the site
1.2 B. Fencing
1.3 D. Storage area
1.4 D. All of the above.
1.5 A. Before construction starts, but only after contracts have been signed
1.6 B. Span over a few years
1.7 C. Nominated materials
1.8 C. Material handling equipment
1.9 A. Construction vehicles
1.10 D. Wood (10 x 1)

2.1 – Excavator
   – Loader
   – Bulldozer
   – Backhoe (4)

2.2 – Concrete: Concrete is a composite material that consists of sand, cement, and gravel or crushed stone. Chemicals are often added to change the properties of the concrete or to speed up the hardening process. Concrete is commonly used for the construction of foundations, load-bearing structures, and sidewalks.

- Bricks: Bricks are historically made using clay. Today, bricks are made using a variety of materials such as soil, sand, clay, lime, and concrete. Bricks are used to build walls or lay paving.
- Ceramics: Ceramics are hard, inorganic materials that are made using minerals. Traditionally ceramics consist of stoneware and porcelain, while modern ceramics consisted of silicon carbide and titanium carbide. Ceramics are commonly used in bricks, mortar, countertops, basins, bathtubs, and tiles.
- Steel: Steel is one of the oldest building materials. The base is an alloy of iron and carbon, with other metals added to improve its properties, thereby creating different varieties, such as stainless steel.
- Aluminium: Aluminium is a lightweight flexible metal. Although it is corrosion resistant, it is highly reactive to a variety of chemicals, such as salt. and is therefore not used in plumbing. Aluminium is commonly used for window and door frames, as well as exterior panels. (3 x 5)

2.3 Subcontractors are contractors who the main contractor hires to complete specific works. The works normally require specialised knowledge or tools to complete, which the main contractor does not have. The main contractor does, however, remain liable for the work that the subcontractor performs. The hiring of subcontractors is a more cost-effective practice as specialised machinery does not have to be acquired, and the main contractor has the luxury of choosing the best value-for-money subcontractor. (5)

2.4 Any ONE of the following: (1)

- Skilled labour
- Semi-skilled labour
- Unskilled labour

Total: 35 marks

Module summary

In this module, students learnt the following:

- Preliminaries are the items that are needed to complete the required works, but do not necessarily form part of the works themselves.
- Preliminaries typically fall under site preparation and include:
  - Site clearing and levelling: Clearing the site of vegetation and rubble and creating a level surface that suits the designed structure
  - Fencing: Used to secure the site, keeping trespassers out while also securing the equipment and tools that are stored there
  - Site office: Used to manage the project from the site and ideal for keeping computers and documents safe
  - Storage areas: Used to store anything from tools to building materials

  - Break area: Used to provide a safe space where workers can spend their breaks
  - Road access: Provides adequate access to the site and prevents any traffic problems
  - Utilities: Provides power and water to the site.
- Measured works are contracts that are based on estimates of the work to be done.
- The two main types of measured work contracts are:
  - BoQ: used where the design and specifications for the project is very precise
  - SoR: used for projects that span a few years and contain uncertainties.
- Day works is a method used to value specifically instructed work, based on the materials, equipment, and time spent by labourers to complete the work.
- Nominated materials are materials that are specified in the plans, specifications, and other project documentation.
- Expenditure is the act of spending money, with each amount being an expense.
- The different types of expenses associated with construction contracts are:
  - On-site overheads: Costs that are related to items and work that is required for the construction of works, excluding management fee, consultant's fee, and off-site overheads.
  - Materials: One of the major expenses of any construction project with various types of material being used, such as:
    - wood
    - concrete
    - bricks
    - glass
    - ceramics
    - steel
    - copper
    - aluminium
    - plastic.
  - Plant and equipment: Used during the construction process, with commonly used equipment being:
    - earth moving equipment
    - construction vehicles
    - material handling equipment
    - hand and power tools.

- Labour: Another major expense of construction projects, consisting of the following different types of labour:
  - » skilled labour
  - » semi-skilled labour
  - » unskilled labour.
- Subcontractors: Hired to complete specific works that require specialised knowledge or equipment.
- Extras: Expenses related to unforeseen circumstances such as breakages or surprise discoveries during site preparation.

MODULE

2 *Main contractors and subcontractors*

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

- explain the roles and responsibilities of a contractor in the pre-tender stage regarding:
  - pre-tender meetings
  - tender preparation
  - site investigation;
- explain the roles, responsibilities and rights of a contractor in terms of:
  - rights and responsibilities
  - finance; and
- explain the roles, responsibilities of a subcontractor.

In this module, students will learn about the role a contractor plays in pre-tender meetings, tender preparation and site investigation. They will also learn what rights and responsibilities the contractor has; not only in the construction project but also regarding finances and subcontractors.

Exercise 2.1 SB page 20

1.1 pre-tender meeting
1.2 executive summary
1.3 detailed
1.4 mechanical
1.5 hydrographical (5)

2.
- Limit client risk
- Limit maintenance costs
- Meet the client's deadlines
- Respond to project changes. (4)

3.
- The possibilities of earthquakes, seasonal flooding, shrinkage, and swelling

- The availability of the required materials in the surrounding areas that include aggregates, road stone, and water for construction
- The tidal ranges and other hydrographical data for structures that must be built near bodies of water
- The results of the soil and rock samples that may influence the foundation design
- The results of the chemical analysis of the soil and groundwater that shows the possibility of it having a negative effect on the foundation structures. (10)

4. Images will boost the look and feel of the proposal ,and support the text by helping to explain difficult concepts. (1)

Total: 20 marks

Exercise 2.2 SB page 26

1.1 Equipment rental
1.2 Site preparation
1.3 Subcontractor
1.4 Finance
1.5 Professional service (5)

2. – Management:
    - » Manage the project budget to ensure that all required activities can be completed.
    - » Find and hire the best subcontractors and workers for the construction activities.
    - » Manage the availability of construction equipment, the flow of building materials, and all other support services required to complete the project.
    - » Manage the waste generated on site.
    - » Submit the bills for payment according to the contract specifications in order to avoid project delays due to non-payment.
  - Monitoring:
    - » Monitor the quality of the workmanship, the construction schedule and safety on site. This is done either directly by the contractor or by an appointed foreman who reports back to the contractor.
    - » Regularly review the project programme and update it as and when necessary.
    - » Try to limit wastage on site by ensuring that economical construction methods are implemented.

- Legal:
  - » Obtain the relevant building permits.
  - » Ensure that the project complies with the building regulations. (10)

3.1 D
3.2 A
3.3 E
3.4 B
3.5 C

Total: 20 marks

Summative assessment SB page 30

1.1 B. Determine the client's needs
1.2 D. Intellectual property
1.3 C. Supplementary
1.4 A. To assess the external factors on site that have to be taken into account for the proposed build
1.5 C. Planning
1.6 B. Monitoring
1.7 C. Contractor
1.8 D. All of the above.
1.9 B. The zone of flooding for a structure to be built next to a river
1.10 C. An explanation of how the work will be carried out (10)

2.1 A contractor must submit a bid that meets the client's needs in order to stand a chance of being selected. The contractor must therefore determine the exact needs or wants of the client. The best way to do this is by attending the pre-tender meeting which shows that the contractor is serious about the work to be done, and provides an opportunity to ask questions to determine the client's needs. During the pre-tender meeting, the contractor will also be able to determine whether the client is serious about the project offer. This way, the situation where the client uses the contractor's solutions without awarding them the contract can be avoided. (5)

2.2 To find out:
- What types of soil layers are present
- What ground water conditions are present
- What the physical properties of the soil types are
- What the mechanical properties of the soil are, for example, how compressible the soil is
- What types of foundations have been used by neighbouring structures and the chemical composition of the groundwater. (5)

2.3 The preliminary stage is carried out during the planning stage of the project. This is when information regarding the type of structure to be built, its intended use, subsoil conditions and the applicable building regulations are gathered. This type of information can usually be found using the following sources:
- Geological survey maps
- Existing soil exploration reports
- Site visits, paying attention to the types of vegetation and the state of the surrounding structures. (5)

2.4 Make sure that a viable safety policy is in place, and that it is adhered to. The policy may include the following:
- Risk management strategies
- Emergency response systems
- Make sure that all workers on-site have access to, and use the required safety equipment
- Promote safety awareness to on-site workers through signage, meetings, and workshops, depending on the type of project. (5)

2.5 – This allows the contractor to transfer the risk to the subcontractor.

Transferring risk is important because:
- If the contractor is responsible for the subcontractor's work it can not only be very costly, but also may lead to legal liabilities.
- It can save the contractor money by lowering the overall cost of a job. (4)

2.6 True (1)

Total: 35 marks

Module summary

In this module, students learnt the following:
- The tender process is used to select a suitable contractor for a construction project.
- An important part of the tender process is the pre-tender meeting.
- A pre-tender meeting is a group event where the tender details can be discussed and is beneficial to contractors in terms of offering them a chance to:
  - meet the client or their buying team, establishing a relationship
  - view the site
  - ask questions regarding the tender and its specifications
  - see who the competitors are
  - decide whether the tender is for their company or not
  - properly prepare for the tender.

- To properly prepare for a tender bid you have to cover three main areas:
  - Client's needs and wants
  - Bid specifications
  - Enhancing your bid.
- Bid specifications refer to the requirements and specifications of the project, with the following critical rules that must be followed:
  - Cover what is asked.
  - Provide an executive summary.
  - Use images.
  - Provided a detailed breakdown of the costing.
  - Provide detailed information on the construction team.
  - Include an NDA.
- To enhance your bid, you have to focus on how your offer will:
  - limit client risk
  - limit maintenance costs
  - meet the required deadlines
  - respond to project changes.
- A site investigation is used to assess the type of soil conditions on site, and to determine the external factors that might influence the proposed structure design.
- The goals of a site investigation are to determine:
  - the types of soil on site
  - ground water conditions
  - physical properties of the soil types
  - the mechanical properties of the soil
  - the types of foundations used for neighbouring structures.
- Information needed to conduct a site investigation includes:
  - The type of structure and what it will be used for
  - Characteristics of the structure
  - Starting date of the project
  - Construction methods to be used
  - The approximate time the construction works will take
  - The probable soil condition on site
  - What the condition of the adjacent structures is.
- A site investigation can be divided into three stages:
  - Preliminary investigation
  - Detailed investigation
  - Supplementary investigation and construction control.

- The preliminary investigation is carried out during the planning stage of the project.
- Sources of information for the preliminary investigation include:
  - Geological survey maps
  - Existing soil exploration reports
  - Site visits, paying attention to the types of vegetation and the state of the surrounding structures.
- The detailed investigation involves collecting soil samples from the site.
- The supplementary investigation and construction control provides the big picture regarding the site, its surroundings, and its soil structure.
- The supplementary investigation provides information regarding the:
  - possibilities of earthquakes, seasonal flooding, shrinkage, and swelling
  - availability of the required building materials in the surrounding areas
  - tidal ranges and other hydrographical data for structures that have to be built near bodies of water
  - results of the soil and rock samples that may influence the foundation design
  - results of the chemical analysis of the soil and groundwater.
- A contractor is any person or company who carries out or manages construction work.
- Some of the general responsibilities of a contractor are:
  - planning
  - management
  - monitoring
  - legal
  - health and safety.
- Finance is the lifeline of any project.
- Depending on the project, the contractor may be financially responsible for:
  - labour
  - equipment rental
  - site preparation
  - acquiring building materials
  - professional services.
- A subcontractor is someone who takes part of a contract from the main contractor and conducts the work on their behalf.
- Subcontractors enable contractors to offer specialised services without necessarily having the know-how or the specialised tools for the job.
- A written agreement between contractors and subcontractors transfers the risk.

- Transferring risk is important because:
  - the contractor being held responsible for the subcontractor's work can be costly and have legal liabilities
  - it can lower the cost of the project, thereby saving the contractor money.
- Once a contractor hires a subcontractor, the financial burden of paying the subcontractor falls on the contractor.
- Subcontractors can be divided into four main categories based on the way they were hired:
  - A nominated subcontractor is a subcontractor that the client chooses, although they are still hired and paid by the main contractor.
  - A selected subcontractor is chosen by the contractor from a recommended list of subcontractors given to him by the client or principal agent.
  - A domestic subcontractor is chosen and hired by the contractor to complete general building work.
  - Direct contractors are hired and paid directly by the client instead of the main contractor.

MODULE

3 *Site meetings and records*

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

- explain how to schedule a site meeting:
  - reasons
  - agenda
  - procedures
  - attendees
  - minutes; and
- explain the contents of the following site records:
  - site diary
  - labour records
  - weather records
  - delays
  - visitors' records
  - material records.

A central part of project schedule management is site meetings. In this module, students will learn why site meetings are necessary, and what procedures should be followed to schedule such a meeting.

Exercise 3.1 SB page 39

1.1 True.
1.2 True.
1.3 False. The first step in arranging a site meeting is to send out an invitation or notice of the meeting.
1.4 False. The agenda of the meeting outlines the structure of the meeting that will take place.
1.5 False. Site meetings of large projects are typically attended by senior level individuals of the respective stakeholders. (5 x 1)

2. Holding regular site meetings ensures that a project is completed:
   - on time
   - within budget
   - according to the contract drawings and specifications
   - with minimal disputes between stakeholders. (4)

3. A typical notice or invitation to the site meeting will consist of the date, time, and the location where the meeting will be held. It is usually accompanied by the minutes of the previous meeting and the agenda of the scheduled meeting. (3)

4. Once the meeting is completed, all the participants can either go to the construction site where the issues raised may be viewed, carry on with their workday, or attend other group meetings. (3)

Total: 15 marks

Exercise 3.2 SB page 43

1.1 B. Weather records
1.2 C. Material records
1.3 A. Delays caused by the contractor
1.4 D. Job card
1.5 B. Direct measurements (5 x 1)

2.1 False. Visitors' records.
2.2 True.
2.3 False. Time sheet.
2.4 False. Weather monitoring system.
2.5 True. (5 x 2)

Total: 15 marks

Summative assessment SB page 48

1.1 C. Construction progress meeting
1.2 B. Communication
1.3 D. Weather reports
1.4 D. All of the above
1.5 A. Reviewing the minutes of the previous meeting. (5)

2. – Any special events that require the contract deliverables to change or be adjusted
   - Testing regimes
   - Mock-ups
   - Quality issues
   - Weather reports

- Issues that have a financial effect
- Health and safety issues
- Issues with neighbouring properties
- Off-site fabrication and the relevant payments
- Design issues. (10 x 1)

3.

Orange Construction – Site meeting minutes			
Project title	Menlyn Housing	Date	6 August 2020
Project No.	4	Time started	09h00
Site meeting No.	6	Time ended	11h00
Minutes prepared by	Student name	Location	Menlyn site
Attendees			
Jack Carver			
Jill Longhorn			
Rory Scott			
Thuli Tsele			
Isaac Mahapa			
Agenda, Notes, Decisions and Issues			
Topic	Discussion		
Welcome	Attendees were welcomed and introduced to Thuli.		
Review minutes	There was a delay in acquiring cement. Since then, a new supplier has been contracted and the supply line is safe.		
Project progress	The construction of the units is 80% complete.		
Issues	The bulldozer broke down.		
Change orders	The scope of work has been changed to include a single garage for the 6 units to be built.		
Payments	The final account of Bladkon is still outstanding.		
Questions and comments	Thuli raised the question of including satellite dishes to the units; it was decided that it will be reserved as an extra option for the buyer.		
Next meeting	20 August 2020 at the Orange Construction boardroom.		

(10)

Total: 35 marks

4.1 Keeping record of all site visitors is important for security, visibility, safety and emergency reasons. (OR any other relevant answer)
4.2 A site diary is a record of the construction project's on-site progress, which includes work that was done, work that was completed, problems that arose and were solved and outstanding issues. (OR any other relevant answer)
4.3 It is important to keep a detailed record of all the delays as they occur to be able to prove to the stakeholders why it happened and what the resulting effects were. (OR any other relevant answer)
4.4. A time sheet is a document that is used to record how a worker's time is spent while on the job. It is usually used along with a clock card system, and the times captured on the sheet must correspond with that of the clock card. (OR any other relevant answer)
4.5 Material records are used to make sure that the materials to be used have the client's approval, to keep test records, and to monitor material levels. (OR any other relevant answer) (5 x 2)

Total: 35 marks

Module summary

In this module, students learnt the following:

- Site meetings are also called construction progress meetings.
- A site meeting is held on site with all the different stakeholders attending to discuss the progress of a project.
- Stakeholders that typically attend site meetings may include the:
  - contractor
  - engineer
  - architect
  - client or their representative
  - representatives of the labourers
  - subcontractors.
- Senior level individuals attend site meetings as decisions are made there and then.
- Regular site meetings will ensure that a project is completed:
  - on time
  - within budget
  - according to the contract drawings and specifications
  - with minimal disputes between stakeholders.
- A site meeting consists of two main parts: project progress and project issues.
- The project progress consists of receiving:
  - progress reports from the contractors
  - progress reports from the consultant team
  - cost reports from the cost consultant
  - records of subcontractors and labourers on site

  - Receiving progress photos.
- The project issues consists of any major issues that require a decision to be made, such as:
  - any special events that require the contract deliverables to change or be adjusted
  - testing regimes
  - mock-ups
  - quality issues
  - weather reports
  - issues that have a financial effect
  - health and safety issues
  - issues with neighbouring properties, and may include:
    - noise
    - dust
    - site access.
  - off-site fabrication and the relevant payments
  - design issues.
- Everything that is discussed during the meeting is recorded in the minutes of the meeting.
- The minutes of the meeting are used to start the meeting, referring back to the issues previously raised and checking if they were resolved or not.
- A notice of the site meeting to be held is sent to all the relevant parties who are expected to attend.
- A typical notice or invitation to the site meeting consists of the date, time, and the location where the meeting will be held.
- The notice is accompanied by the minutes of the previous meeting and the agenda of the scheduled meeting.
- The agenda and the minutes allow the attendees time to prepare for the meeting, and also provides structure to the proceedings of the meeting.
- A typical site meeting agenda consists of the following points:
  - All attendees sign an attendance register and absent participants are listed.
  - Review the minutes of the previous meeting and update the status of any pending issues.
  - Discuss any problems which may include:
    - material shortages
    - site problems
    - shop drawing approvals
    - construction conflicts.
    - review the progress schedule and identify the reasons for any delays.
    - give each participant an opportunity to add new business or to indicate no new business.

    - » discuss the status of any change orders that are currently in progress.
    - » discuss contractor payment issues and payment approvals.
    - » discuss any equipment or staff issues and changes.
    - » allow time for any questions or comments.
    - » schedule and verify the date, time, and location of the next site meeting.
    - » End meeting.
- Site records are a very important part of any construction project no matter the size of the company or project.
- A site diary is a record of the construction project's on-site progress, and it provides a bigger picture view of the project's overall progress and its quality.
- As labour is one of the main contributing factors when it comes to project costing, it is important to keep detailed records of the labour hours. Some of the ways to record labour hours include:
    - clock cards
    - daily or weekly time sheets
    - job cards.
- Weather is unpredictable and, depending on the site location, the conditions can change in an instant. There are three types of weather data that are used on a construction site:
    - Historical data
    - Weather forecasts
    - Direct measurements.
- When managing a construction project, the main goal is to complete it as soon as possible and at minimal cost. Common construction project delays include:
    - Contractor-caused delays
    - Owner-caused delays
    - External factor delays.
- Keeping record of all site visitors is important for the following reasons:
    - Security
    - Visibility
    - Safety
    - Emergencies.
- A typical method used to record visitors to the construction site is a sign-in and sign-out book that is usually placed at the security post or site office.
- Material records are used to ensure that the materials to be used have the client's approval. It is also used to record the test results that will serve as proof should any quality-related disputes arise.
- Apart from the quality records, the quantity of materials is also continuously recorded. This is used to monitor material levels and avoid construction standstill due to materials being depleted.

MODULE

4 *Mechanical plants*

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

- describe the functions and the magnitude of the following plants:
  - concrete mixing plant
  - stone crushing plant
  - bitumen mixing plant;
- describe the various types of cranes and their uses;
- identify the correct plant for the project;
- criteria for the selection of a plant and equipment; and
- demonstrate an understanding regarding the need for maintenance of equipment, including:
  - maintenance of plants and equipment
  - planned maintenance
  - preventive maintenance
  - maintenance check list.

The earliest use of concrete for construction dates back to 6500 BC in the regions of Syria and Jordan. It became the main building material used by the Romans, who used a mixture of volcanic ash, lime and seawater to build structures that are still standing today.

Exercise 4.1 SB page 68

1.1 G. Semi-automatic plant
1.2 J. Crawler crane
1.3 I. Transit mix
1.4 H. Self-erecting tower crane
1.5 A. Jaw crusher (5 x 1)

2. The production process consists of weighing, drying, heating, and separating the aggregates, whereafter it is mixed with bitumen and additional ingredients. The final product is then loaded onto trucks or into silos. (3)

3. – Drum dryer
   – Coal burner
   – Aggregate supply system
   – Dust collector
   – Screening unit
   – Hot bins
   – Aggregate weigh hopper
   – Pugmill mixer. (8 x 1)

4. The cone crusher is a machine that uses compression to crush rocks. The rock is fed into the crusher from the top. The rock is then caught between the off-centre placed rotating cone and the cone feed plate. This crushes the material that then drops down to be unloaded at the bottom. The size of the product is adjusted by adjusting the gap between the cone and the feed plate. (5)

5. Racking is the action of moving the load horizontally via the trolley running along the jib of crane. (2)

6. Static cranes and mobile cranes (2)

Total: 25 marks

Exercise 4.2 SB page 70

1.1 Economic factors
1.2 Timeline factors
1.3 Equipment factors
1.4 Jobsite factors
1.5 Labour factors (5 x1)

2. – Safety factors: Construction sites are inherently dangerous, and the safety of everyone on site is first priority. To achieve this, equipment that enhances the safety of all involved is considered above the equipment that does not. (2)
   – Company factors: These factors refer to the company's needs and capabilities. If the company has a number of projects lined up, then investing in heavy construction equipment would make sense. However, if there is only one small project, renting might be a better option. The amount of in-house work also influences the decision because if the company outsources a lot of work, it would not make sense to invest in equipment. (3)

Total: 10 marks

Exercise 4.3 SB page 73

1.1 maintenance
1.2 reactive
1.3 predictive
1.4 infrared
1.5 lubricants (5 x 1)

2. IIoT is the application of IoT technology in the industrial sector. IoT is the internet of things which refers to a network of physical objects or things that are embedded with sensors, software, and other technologies that are used to connect and exchange data with other devices and systems over the internet. (4)

3. A method of analysing rotating machinery to detect any imbalance, misalignment, or loose parts in it (1)

Total: 10 marks

Summative assessment SB page 77

1.1 D. All of the above
1.2 B. Automatic
1.3 A. Charging
1.4 D. Hot bins
1.5 D. 70
1.6 B. Roller crusher
1.7 A. Hammerhead crane
1.8 C. Crawler
1.9 D. Company factors
1.10 B. Internet of things (10 x 1)

2.1 This type of crusher uses impact to crush the stone loaded into its crushing chamber. There are two types of impact crushers:

- Horizontal shaft impactor (**HSI**): The HSI has stone crushing hammer bars that are fixed to a horizontally- positioned shaft and rotor. The HSI is normally used for the crushing softer materials such as gypsum, limestone, and phosphate.
- Vertical shaft impactor (**VSI**): The method of impact is different in the VSI than in the HSI. The material that is fed into the VSI is accelerated by its high rpm rotor. The material is then flung outwards and into the crushing chamber where it hits the anvil ring assembly. The impact of the material against the anvil ring crushes it. The coarseness of the material is determined by the speed of the rotor. The faster it spins the finer the particles will be. (8)

2.2
- Air
- Additives
- Fly ash
- Silica fumes
- Slag. (5)

2.3 Any THREE of the following:
- Coal
  - » Stone
  - » Granite
  - » Limestone
  - » Basalt
  - » River stone
  - » Andesite calcite. (3)

3.1.1 Luffing tower crane: A luffing tower crane has a design similar to the hammerhead and is able to slew 360°. It is also able to luff its jib. It is able to lift heavier loads than the hammerhead and is suitable for work in congested areas. (4)

3.1.2 Level-luffing crane: A level-luffing crane consists of a vertical mast with a double jib that can slew. Instead of using a trolley and hook block like the hammerhead crane, the double jib itself moves inward and outward enabling the crane to keep the load level and minimise load sway. It is suited for any construction site. (4)

3.1.3 All-terrain crane: An all-terrain crane is a crane that is mounted on a truck that is able to travel on roads at highway speeds, as well as off-road. Depending on the size of the crane, the truck can have anywhere between 4 and 18 wheels. The crane, which has a telescopic boom, is mounted on the bed of the truck and has a load capacity of 1 200 tonnes. The crane is operated from a cab that swivels with the boom as it moves. The all-terrain crane uses outriggers to stabilise it and counterweights to balance it. (4)

3.2 Any TWO of the following:
- Bridge crane
- Gantry crane
- Monorail crane
- Jib crane
- Workstation crane. (2)

4.1 The right equipment can have a positive effect on efficiency, cost savings, on-site safety, and overall profitability. (2)

4.2
- Possible secondary damage to surrounding equipment that must also be repaired
- Operations being shutdown to conduct maintenance, causing delays in supplying customers and thereby, costing the company money
- Labour and cost of spare parts that need to be acquired within a short amount of time, thereby driving up the cost. (3)

4.3 Predictive maintenance is a maintenance method that involves using technology to analyse a piece of equipment's condition, status, and performance in real time. Data is collected during normal operations and continuously analysed. If an abnormality is detected, the owner or operator is notified, and the chance of unexpected machine failure is reduced. The technology that allows the real-time data collection and analyses it, is called condition-based monitoring and industrial internet of things (IIoT) technology. (5)

Total: 50 marks

Module summary

In this module, students learnt the following:

- Plants utilised on large construction sites include:
  - concrete mixing plants
  - stone crusher plants
  - bitumen mixing plants.
- A concrete mixing plant is also called a batching plant and combines various ingredients at a central location to produce concrete.
- A concrete mixing plant can supply various types of concrete by adding ingredients such as air, additives, fly ash, silica fumes, and slag.
- The concrete plant itself may consist of a combination of various components that include:
  - Mixers:
    - » tilt drum
    - » horizontal drum
  - Cement batchers
  - Aggregate batchers
  - Conveyors
  - Radial stackers
  - Aggregate bins
  - Cement bins
  - Heaters

  - Chillers
  - Cement silos
  - Batch plant controls
  - Dust collectors.
- Concrete plants are often categorised according to their mode of function which are either manual, semi-automatic, or automatic.
- The different types of concrete batching plants commonly used on construction sites are:
  - commercial concrete batching plant
  - dry mix concrete batching plant
  - wet mix concrete batching plant
  - mobile concrete batching plant:
    - » stationary concrete batching plant
    - » tower concrete mixing plant
    - » containerised concrete batching plant.
- A stone crusher plant is used to reduce big rocks to a smaller size, such as aggregate or dust, based on what it will be used for.
- Types of materials that are commonly processed by a stone crusher include:
  - coal
  - stone
  - granite
  - limestone
  - basalt
  - river stone
  - andesite calcite.
- Main components in a typical stone crusher plant include:
  - loading
  - feeding
  - unloading
  - conveying
  - separating
  - crushing.
- A primary crusher plant crushes material that comes directly from a mine.
- A secondary crusher crushes material that has already been through the crushing process and reduces its size even further.
- The selection criteria applied to a crusher plant include:
  - production requirement
  - ore characteristics
  - operational considerations

  - capital cost.
- Types of stone crushers are:
  - jaw crusher
  - cone crusher
  - roller crusher
  - impact crusher:
    - HSI
    - VSI.
- Bitumen is a material that is produced by the distillation of crude oil.
- A bitumen plant mixes aggregates with sand, stone dust, and the correct amount of bitumen that is used to construct roads.
- The main components of a bitumen plant are:
  - drum dryer
  - coal burner
  - aggregate supply system
  - dust collector
  - screening unit
  - hot bins
  - aggregate weigh hopper
  - pugmill mixer.
- A crane is a type of machine that generally uses a hoist rope, wire ropes or chains and sheaves to lift, lower, and move materials horizontally.
- Cranes can be divided into two main types, namely static and mobile.
- A static crane is a type of crane that is semi-permanently or permanently fixed to the ground or a building and can only move in a fixed path.
- The different types of static cranes are:
  - overhead cranes
  - tower cranes:
    - hammerhead crane
    - luffing tower crane
    - self-erecting tower crane
    - level-luffing crane.
- A mobile crane is a crane that is mounted on a truck or any other vehicle type that uses treads or tyres.
- The different types of mobile cranes include:
  - crawler cranes
  - all-terrain cranes
  - truck cranes
  - carry deck cranes.

- Selection of the correct construction equipment can have a positive effect on efficiency, cost savings, safety, on-site and overall profitability.
- General factors that influence the selection of equipment include:
  - economic factors
  - company factors
  - jobsite factors
  - timeline factors
  - labour factors
  - safety factors
  - equipment factors.
- The actions taken to prevent equipment from failing is called maintenance.
- General maintenance activities include:
  - Checking the plant and equipment condition
  - Planning and keeping the necessary spare parts, lubricants, and other consumables
  - Scheduling and planning procedures that will optimise the plant and equipment
  - Performing physical maintenance activities.
- The different types of maintenance are:
  - reactive maintenance
  - preventative maintenance
  - predictive maintenance.
- Reactive maintenance involves running the equipment until it breaks.
- Reasons that make equipment breakdowns costly, include:
  - Possible secondary damage to surrounding equipment
  - Operations being shutdown to conduct maintenance
  - Labour and cost of spare parts that need to be acquired within a short amount of time.
- Preventative maintenance involves conducting maintenance tasks according to a time or machine-run time schedule.
- Preventative maintenance does not prevent equipment failure completely but it does decrease the likelihood of it happening.
- Predictive maintenance involves using technology to analyse a piece of equipment's condition, status, and performance in real time.
- The technology that allows the real-time data collection, as well as analyses it, is called condition-based monitoring and IIoT technology.
- Specific types of predictive maintenance enabled by the technology include:
  - vibration analysis
  - infrared analysis
  - sonic acoustical analysis.

MODULE

5 *Support to structures*

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

- explain the excavation of trenches in terms of:
  - causes of collapse
  - preventing collapse
  - planking and strutting on various kinds of soil;
- identify and draw the various types and uses of shoring such as:
  - raking shores
  - dead shores
  - flying shores
  - double flying shores; and
- explain the use of underpinning in:
  - enlarging concrete footings
  - jacked piles.

Foundations are the base of any structure and as discussed in Module 7 of *N4 Building Administration*, if the foundation is not strong enough the structure is sure to collapse. A part of the process of constructing a proper foundation is excavation, which in and of itself can be very dangerous if one considers that most fatal accidents occur during this phase of construction. The excavation of soil is also used during repair or maintenance activities where trenches have to be dug to gain access to underground piping or cables. In this module, students will learn about the excavation of trenches, the possible causes of trench collapse, and how it can be prevented. Students will learn about the various types of shoring that is commonly used, and how underpinning is utilised to repair weakened foundations.

Exercise 5.1 SB page 88

1.1 True.
1.2 False. A trenching hoe is typically used to chop up surface soil and drag it up the ramped-up end of the trench.
1.3 True.
1.4 False. Runners are iron-shod wooden planks that are hammered into the ground to a depth of 300 mm.

1.5 True. (10)

2. – Properly identify the soil type, which will determine the type of safety equipment required.
   – Have daily inspections done by a competent person before workers enter the trench.
   – Use a shield or trench box system.
   – Slope both sides of the trenches thereby reducing the weight.
   – Keep excavated soil, materials, and equipment at least 600 mm from the trench edges.
   – Use engineered sheeting or bracing on the trench walls. (6)

3.1 Stay bracing
This method is used in soil that is moderately firm and where the excavation is no more than 2 m deep. Here polling boards that are 350 mm wide and 40 to 50 mm thick are kept in place using one or two struts. The polling boards are placed so that they cover a 3 m to 4 m distance, and span from the bottom to the top of the trench. (3)

3.2 Sheet piling
The sheet piling method is used when the excavation covers a large area of soil that is loose and soft. The excavation depth is greater than 10 m with the trench width being bigger than usual. The two types of sheet piling used are:
   – wooden sheet piles – used for depths of 10 m
   – steel sheet piles – used for depths up to 30 m. (4)

4. A portable trencher is a lightweight machine that is used for landscaping and irrigation purposes. (2)

Total: 25 marks

Exercise 5.2 SB page 93

1.1 Structure failure
1.2 Raking
1.3 Flying
1.4 Vertical
1.5 Struts (5)

2. A: Sole plate
   B: Rakers
   C: Cleat
   D: Needle
   E: Hoop iron (5)

3. – Rakers must be positioned as close as possible to an angle of 45° to the ground. Angles between 45° and 75° are acceptable.
   – Rakers must be properly braced.
   – The size of the rakers must be determined by the expected thrust of the wall it supports.
   – The spacing of rakers may vary from 3 m to 4,5 m.
   – The sole plates must be a suitable size, and must be thoroughly secured into the ground. (5)

4. The dead shores members are removed at two-day intervals, in the following order:
   – Needles
   – Strutting
   – Floor strutting
   – Raking shores (if applicable). (5)

Total: 20 marks

Exercise 5.3 SB page 97

1.1 D. Mass concrete
1.2 E. Push piers
1.3 A. Underpinning
1.4 C. Helical tiebacks
1.5 B. Beam and base (5)

2. – The foundation is not strong enough to support the existing superstructure.
   – The functional purpose of the structure has changed, thereby requiring reinforcing.
   – The soil is not suitable to carry the load of the structure.
   – Another storey has to be added to the superstructure, and the original foundation was not built for this purpose.
   – Acts of God have compromised the structural integrity. (5)

Total: 10 marks

Summative assessment SB page 102

1.1 B. A is a deep trench and B is a shallow trench.
1.2 C. Trenching shovel
1.3 D. Chain trencher
1.4 A. The soil walls collapse under their own weight.
1.5 C. Soil strength
1.6 B. Strengthen a structure's foundation

1.7 C. The amount of moisture in the soil
1.8 B. Support the sheeting or polling board
1.9 D. All of the above.
1.10 C. Skimmer (10 x 1)

2.1 – Bulging at the bottom of the walls of the trench
– Tension cracks on the surface that runs parallel to the trench walls. (2)

2.2.1 A planking and strutting or timbering method, also called double stage timbering, is used in loose soil where the excavation depth is no more than 10 m. If a trench has multiple stages, each stage will use a vertical sheet, horizontal walling, struts and bracing. (4)

2.2.2 A planking and strutting or timbering method that is used in loose soil where the excavation depth is no more than 4 m. A box structure is created using sheeting, walling, struts, and bracing. (3)

2.3 – Digging: The process of excavating earth from the surface using hand tools or machinery, creating a hole or any other shape.
– Dredging: The process of excavating earth from a water environment, with the goal of altering drainage, reshaping land or constructing dams to name but a few.
– Trenching: The process of excavating earth to create a narrow cut in the surface, where its length is greater than its width and depth. (6)

3.1 – (a) Dead shoring or vertical shoring
– (b) Raking shoring
– (c) Double flying shoring (3)

3.2 Dead shoring or vertical shoring is a system that is designed to support the dead load or total weight of a structure. The system consists of vertical members called dead shores and horizontal members called needles that support the structure above and transfer its weight to the ground. In the scenarios where window or door openings must be made in existing walls, they are cut large enough so that the needles can be placed in them. The needles are then supported by dead shores at the ends of either wall. The dead shores are, however, not placed against the walls so as to allow space to work. As the wall cutting process might cause vibrations and shocks, raking shores are often erected before cutting begins to ensure worker safety. (8)

3.3 – Wall plates
– Needles
– Cleats
– Horizontal struts
– Inclined struts. (5)

4.1 – Mass concrete underpinning
– Beam and base underpinning
– Mini-piled underpinning (3)

4.2 These piers are similar to push piers; they are galvanised steel squares or round tubing that is driven into the ground and attached to the foundation footing. These piers have helices at their bottom ends that increases its maximum load bearing capacity up to 33 tonnes. (3)

4.3 A. Existing foundation
B. Metal shims
C. Helical pier shaft at an angle (3)

Total: 50 marks

Module summary

In this module, students learnt the following:

- Excavation is the process where earth and other materials are moved using tools, machinery, or explosives.
- Excavation is used to construct structure foundations, roads, canals, and reservoirs.
- The excavation process consists of the following various activities:
  - digging
  - dredging
  - trenching.
- A trench can either be shallow (< 6 m deep) or deep (> 6 m deep).
- The equipment used for trenching include:
  - trenching shovel
  - trenching hoe
  - wheel trencher
  - chain trencher
  - skimmer
  - micro trencher
  - portable trencher
  - tractor mount trencher.
- The single biggest danger when it comes to excavation is cave-ins, which are most likely to result in the death of a worker(s).
- Cave-ins occur when gravity overcomes the ability of the soil to support its own weight.
- Signs of a possible cave-in can be identified by:
  - bulging at the bottom of the walls of the trench

  - tension cracks on the surface which run parallel to the trench walls.
- Three main factors which influence soil stability, are:
  - soil strength
  - gravitational factors
  - environmental factors.
- The gravitational factors that work against the soil strength include the:
  - depth of the trench
  - weight of the soil
  - weight of the surcharge.
- Precautions to be taken in order to prevent trench collapse include:
  - Properly identifying the soil type
  - Daily inspections by a competent person before workers enter the trench
  - Using a shield or trench box system
  - Sloping both sides of the trenches thereby reducing the weight
  - Keeping excavated soil, materials and equipment at least 600 mm from the trench edges
  - Using engineered sheeting or bracing on the trench walls.
- Planking and strutting is used to provide temporary support to trench walls and consists of the following main components:
  - polling board
  - sheeting
  - wales or walling
  - struts
  - bbracing
  - rsunners.
- The different timbering methods commonly used are:
  - stay bracing
  - box sheeting
  - vertical sheeting
  - runners
  - sheet piling.
- The two types of sheet piling used are:
  - wooden sheet piles
  - steel sheet piles.
- Shoring is used to prevent trench collapse, as well as to provide support during a structure's construction.
- The different types of shoring are:
  - raking shoring

  - dead shoring
  - flying shoring.
- The raking shoring method uses members called rakers to provide lateral support to the walls and consists of the following components:
  - rakers
  - wall plates
  - needles
  - cleats
  - bracing
  - sole plates.
- Things to consider when raking shoring is used include:
  - Rakers must be positioned as close as possible to an angle of 45° to the ground.
  - Rakers must be properly braced.
  - The size of the rakers must be determined by the expected thrust of the wall it supports.
  - The spacing of the rakers may vary from 3 m to 4,5 m.
  - The sole plates must be of a suitable size and must be thoroughly secured into the ground.
- Dead shoring is a system that is designed to support the total weight of a structure and provides vertical support to:
  - temporary walls
  - roofs
  - floors.
- Dead shoring is typically used where:
  - a defective load bearing wall must be rebuilt
  - unsafe foundations must be strengthened or replaced
  - an opening for a door or window must be created in a lower level of a multi-storey structure
- Things to consider when dead shoring is used include:
  - All floors and openings near and above the dead shore must be properly supported before needle beams and vertical posts are installed.
  - The needles and dead shores used must be able to transfer the estimated load completely.
  - Needles must be spaced 1 m to 2 m apart.
  - Needles must be properly braced.
  - When an opening is made in an external wall, the outer dead shore must be of a longer length than the inner dead shore.
  - Raking shores along with dead shores must be used when the external wall is weak.

  - After the new construction has gained the desired strength, the dead shores members may be removed, at two-day intervals.
- The flying shoring system is used to provide temporary support to the parallel walls of two adjacent buildings.
- The shores of the flying shoring do not reach the ground and are positioned horizontally.
- The main components of the flying shore are:
  - wall plates
  - needles
  - cleats
  - horizontal struts
  - inclined struts.
- Things to consider when flying shoring is used include:
  - Flying shores and struts must be placed at the correct height based on the associated floor strength.
  - The struts must be inclined between 45° and 65°.
  - A single flying shore must not be used for a span of more than 9 m.
  - The spacing between flying shores must be between 3 m and 4,5 m.
  - Safety is a priority when it comes to the design of the flying shore structure.
- Underpinning is the process of strengthening and reinforcing an existing foundation by extending the depth and width of the foundation.
- Reasons to underpin a structure's foundation include:
  - The foundation is not strong enough to support the existing superstructure.
  - The functional purpose of the structure has changed, thereby requiring reinforcing.
  - The soil is not suitable to carry the load of the structure.
  - Another storey has to be added to the superstructure and the original foundation was not built for this purpose.
  - Acts of God have compromised the structural integrity.
- The three main types of underpinning are:
  - mass concrete underpinning
  - beam and base underpinning
  - mini-piled underpinning.
- The three types of mini-piled underpinning are:
  - push piers
  - helical piers
  - helical tiebacks.

MODULE

6 *Mass haul diagrams*

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

- determine the cut and fill for given plotted ground surface shapes using:
  - Simpson's rule
  - middle ordinate method;
- calculate the accumulated earth work volumes from given data; and
- illustrate the use of a mass haul diagram.

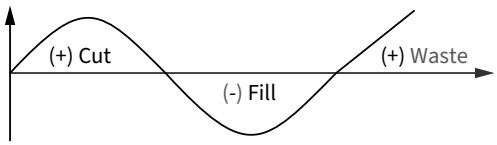
In this module, students learn how to calculate the volumes of earth to be moved, and the different methods used to do so. They also learn how a mass haul diagram is used in the planning process of earthworks to ensure that the work is done in the most cost-saving and efficient way.

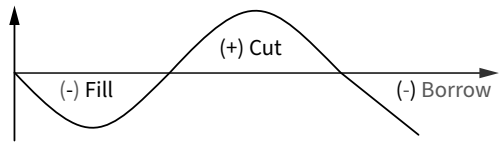
Exercise 6.1 SB page 124

1.1 2D model
1.2 Saddle
1.3 Cliff
1.4 Volume
1.5 Simpson's rule/ Simpson's 1/3 rule/ parabolic rule
1.6 Mid-ordinate method
1.7 Mass haul diagram
1.8 Average haul distance
1.9 Grade point
1.10 Maximum hauled distance (10 x 1)

2. – Waste: The volume of surplus material that must be disposed of after earth-moving activities, for a specific section to be completed.
   – Borrow: The volume of material that must be imported from an offsite location due to the shortage of fill material, to complete earth-moving activities for a specific section. (2)

3.





(2 x 2)

4.

Average cut surface area = $\frac{2\,680 + 3\,840 + 4\,130}{3} = 3\,550\ m^2$

Average cut surface area = $\frac{4\,110 + 2\,580 + 4\,800}{3} = 3\,830\ m^2$

Cut volume = $3\,550\ m^2 \times 50\ m$
Cut volume = $177\,500\ m^3$

Fill volume = $3\,830\ m^2 \times 50\ m$
Fill volume = $191\,500\ m^3$

$191\,500\ m^3 - 177\,500\ m^3 = 14\,000\ m^3$

There will be a shortage of earth with a volume of $14\,000\ m^3$. (10)

5. Total area = $\frac{\text{common distance}}{3}$ [first ordinate + last ordinate + 4 (sum of even ordinates) + 2 (sum of remaining odd ordinates)]

Total area = $\frac{15}{3}$ [3,50 + 0 + 4 (4,30 + 5,25 + 8,80 + 4,40) + 2 (3,50 + 6,75 + 7,50 + 7,90 + 0)]

Total area = $\frac{15}{3}$ [3,50 + 4 (22,75) + 2 (25,65)]

Total area = $\frac{15}{3}$ [3,50 + 91 + 51,3]

Total area = $\frac{15}{3}$ [145,80]

Total area = $\frac{2\,187}{3}$

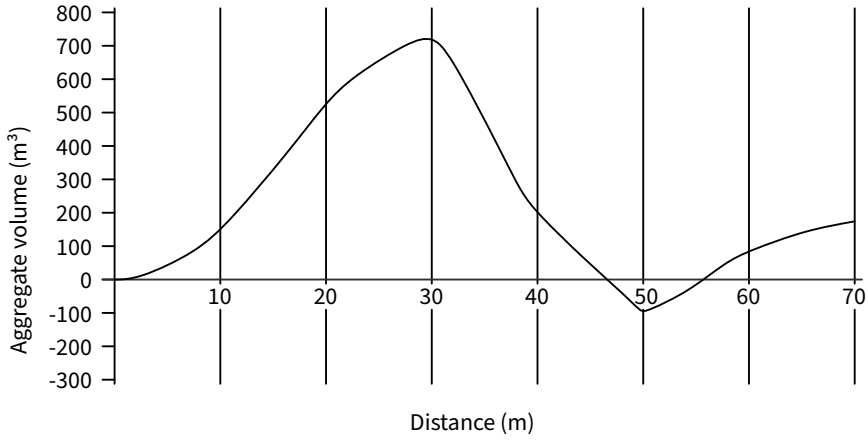
Total area = $729\ m^2$ (4)

6.1

Section	Area	Cut section volume	Fill section volume	Aggregate volume
1	15 m^2	150		150
2	37 m^2	370		520
3	20 m^2	200		720
4	50 m^2		500	220
5	28 m^2		280	– 60
6	17 m^2	170		110
7	8 m^2	80		190

(8)

6.2



(2)

Total: 40 marks

Summative assessment SB page 128

1.1 C. Cut and fill
1.2 B. Hill
1.3 D. Ridge
1.4 A. Multiplying the distance between cross sections with the average surface area
1.5 B. Multiply the common distance with the sum of the ordinates
1.6 C. Mass haul diagram
1.7 D. Free haul distance
1.8 D. Haul distance
1.9 B. Total filling volume
1.10 C. Rising; cutting (10)

2.1 The mid-ordinate method, because there are an even number of ordinates and Simpson's rule requires an odd number of ordinates. (2)

2.2 $h_1 = \frac{30 + 33}{2} = 31{,}5$ m

$h_2 = \frac{33 + 30}{2} = 31{,}5$ m

$h_3 = \frac{30 + 38}{2} = 34$ m

$h_4 = \frac{38 + 30}{2} = 34$ m

$h_5 = \frac{30 + 18}{2} = 24$ m

$h_6 = \frac{18 + 11}{2} = 14{,}5$ m

$h_7 = \frac{11 + 18}{2} = 14{,}5$ m

Area = common distance × sum of mid-ordinates
Area = 5 m × (31,5 + 31,5 + 34 + 34 + 24 + 14,5 + 14,5)m
Area = 5 m × 184 m
Area = 920 m^2 (10)

2.3 The type of cut and fill model used depends mainly on the level of accuracy required, access to the site, and the equipment at your disposal. (3)

3.1

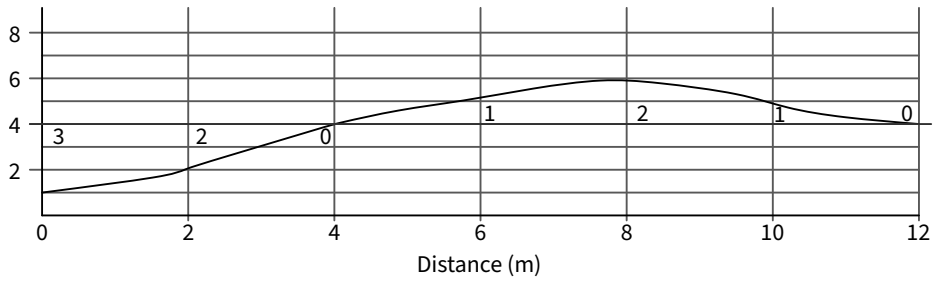
(2)

3.2 With proposed formation level the ordinates are:
Fill section:

- First ordinate: 3
- Last ordinate: 0
- Even ordinates: 2
- Odd ordinates: -

Cut section:

- First ordinate: 0
- Last ordinate: 0
- Even ordinates: 1; 1
- Odd ordinates: 2



Fill section:

Total area = $\frac{\text{common distance}}{3}$ [first ordinate + last ordinate + 4 (sum of even ordinates) + 2 (sum of odd ordinates)]

Total area = $\frac{2}{3}$ [3 + 0 + 4 (2) + 2 (0)]

Total area = $\frac{2}{3}$ (11)

Total area = $\frac{22}{3}$

Total area = 7,33 m^2

Cut section:

Total area = $\frac{\text{common distance}}{3}$ [first ordinate + last ordinate + 4 (sum of even ordinates) + 2 (sum of odd ordinates)]

Total area = $\frac{2}{3}$ [0 + 0 + 4 (1 + 1) + 2 (2)]

Total area = $\frac{2}{3}$ [4 (2) + 2 (2)]

Total area = $\frac{2}{3}$ [8 + 4]

Total area = $\frac{2}{3}$ (12)

Total area = $\frac{24}{3}$

Total area = 8 m^2 (6)

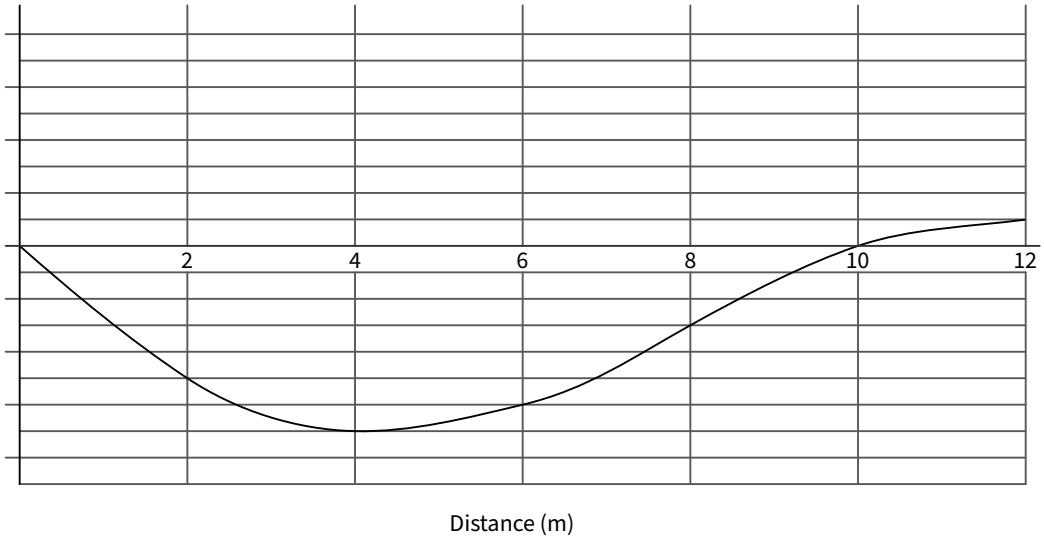
3.3 Fill volume = 7,33 $m^2 \times$ 10 m
Fill volume = 73,3 m^3
Cut volume = 8 $m^2 \times$ 10 m
Cut volume = 80 m^3 (2)

3.4 Given information:

- Fill ordinates: 3; 2; 0
- Cut ordinates: 0; 1; 2; 1; 0
- Common distance: 2 m
- Distance between cross sections: 10 m
- Determine the aggregate volume.

Section	Mid-ordinates	Area	Section volume	Aggregate volume
1	$h_1 = \frac{3+2}{2} = 2,5$ m	$2,5 \times 2 = 5$ m^2	– 50 m^3	– 50 m^3
2	$h_2 = \frac{2+0}{2} = 1$ m	$1 \times 2 = 2$ m^2	– 20 m^3	– 70 m^3
3	$h_3 = \frac{0+1}{2} = 0,5$ m	$0,5 \times 2 = 1$ m^2	+ 10 m^3	– 60 m^3
4	$h_4 = \frac{1+2}{2} = 1,5$ m	$1,5 \times 2 = 3$ m^2	+ 30 m^3	– 30 m^3
5	$h_5 = \frac{2+1}{2} = 1,5$ m	$1,5 \times 2 = 3$ m^2	+ 30 m^3	0 m^3
6	$h_6 = \frac{1+0}{2} = 0,5$ m	$0,5 \times 2 = 1$ m^2	+ 10 m^3	10 m^3

Plot the mass haul diagram:



(25)

Total: 60 marks

Module summary

In this module, students learnt the following:

- The process of excavating material in one place and depositing it at another nearby place is called cut and fill.
- The earth-moving process is expensive. Therefore, planners use cut and fill maps to limit waste.
- There are 2D and 3D model cut and fill maps, with the type of map being used determined by the required accuracy.
- The 2D model is a cross section along a positive X-axis and a positive and negative Y-axis.
- Multiple cross sections are created at regular intervals to capture the landscape, with smaller intervals providing a more accurate model.
- 3D models are created using accurate surveying equipment to collect multiple data points and use different colours to present the elevation ranges.
- Cut and fill maps have the following common terrain features:
  - Hill
  - Saddle
  - Valley
  - Ridge
  - Depression
  - Cliff.

- The cross-section method can be used to calculate cut and fill volumes.
- Cut volumes and fill volumes are added to determine whether there will be an excess of material that must be disposed of, or if extra material must be sourced to form the proposed formation level.
- One of two methods can be used to determine the surface area of a cross section, namely the Simpson's rule method or the mid-ordinate method.
- Simpson's rule uses a parabola to calculate the area under the curve with the parabola creating a smooth curve between ordinates.
- The mid-ordinate method uses equally sized rectangles that span from ordinate to ordinate, with their mid-points intersecting the curve.
- The surface area of each rectangle is calculated and added to determine the surface area under the curve.
- A mass haul diagram is a tool used in the planning process of moving cut and fill material.
- Key terms used in connection with mass haul diagrams include:
  - haul
  - haul distance
  - average haul distance
  - free haul distance
  - overhaul distance
  - waste
  - borrow
  - grade points
  - balance points.
- Common characteristics of a mass hall diagram are:
  - The rising curve indicates cutting as the aggregate volume is increasing.
  - The maximum point on the curve denotes the end of the cut.
  - The falling curve indicates filling as the aggregate volume is decreasing.
  - The minimum point of the curve denotes the end of the fill.
  - The vertical difference between the maximum and the following minimum point represents the total filling volume.
  - The vertical difference between any two points, not including the minimum or maximum point between them, represents the volume of earthwork between the two points.
  - If a horizontal line is drawn intersecting the curve at two points, the cut volume will equal the fill volume between these two points.
  - Where the horizontal balancing line intersects the curve, the area above the line indicates the volume that must be shifted forward and the area under the line indicates the volume that must be shifted backwards.

  - The length of the balancing line between intersecting points represents the maximum hauled distance in the section. With areas above the line indicating the distance of material to be shifted forward and areas beneath the line indicating the distance of material to be shifted backwards.
- To create a mass hall diagram, you must complete the following steps:
  - Step 1: Determine the areas of each section between the ordinates.
  - Step 2: Determine the volume of the cut and fill cross sections with regards to the formation level. With all cut values considered positive and all fill values considered negative.
  - Step 3: Calculate the aggregated algebraic volume for each cut and fill section.
  - Step 4: Plot the mass haul curve using the aggregated volumes as ordinates and the same scale for the base line as used for the profile.

MODULE

7 *Variations, omissions and handover*

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

- explain in which scenario each of the following can be used:
  - variations
  - day works
  - omissions
  - extras
  - additional works; and
- explain the procedures to be followed and the responsibilities when handing over a project.

Construction contracts form the basis for all construction projects, large and small. In the contract, the project is set out in full with each deliverable described in detail, informing every party involved what is expected of them.

But what happens if a specified task cannot be completed in the manner as described in the contract? What if contractors have to push through and try to deliver under difficult conditions? What if the original design is not the best option?

In the end, these types of scenarios carry a financial implication, either during the project or after it has been completed.

Exercise 7.1 SB page 138

1.1 Design
1.2 Omissions
1.3 Day
1.4 Variation
1.5 Compliance

2.1 Variation: Changes to the original scope of work agreed upon, as set out in the contract. (2)

2.2 Condition changes: A change in environmental and economic conditions that have a direct effect on the scope of work of the project. A change in economic conditions refers to an economy that weakens and brings about stiff competition. This in turn, has a direct effect on the client and company finances in the form of tight loan requirements and more expensive building materials.

A change in environmental conditions refers to things such as extreme weather conditions that affects labour and material availability, as well as equipment damage and efficacy. (5)

3. Variations are sometimes necessary as they provide some form of flexibility to the contractor. Without this flexibility, the end product might be one of lesser quality due to the contractor being forced to work, while factors that are out of their control, influences the project. (3)

4. Any ONE of the following:
   - Breach of contract between the contractor and the client
   - Breach of contract between the contractor and subcontractor (1)

5. The testing and commissioning data of the various assets to be handed over to the client is gathered. This includes:
   - all the necessary construction certificates
   - inspection and as-built documentation
   - operation and maintenance manuals. (4)

Total: 20 marks

Summative assessment SB page 140

1.1 B. Technological advancement
1.2 C. Condition changes
1.3 D. All of the above.
1.4 A. Change in the availability of materials
1.5 B. Percentage addition
1.6 C. Defect management
1.7 D. Handover
1.8 D. None of the above.
1.9 A. Testing and commissioning
1.10 C. Statutory change (10 x 1)

2.
   - Time needed to complete the work
   - Materials required
   - Labour required
   - Equipment and machinery required. (4)

3. – Additional work is work that falls within the original scope of the contract and originates from the tasks that were originally contracted for. The cost of additional work is not added to the original contract amount, although a time extension to complete the project is often granted.
   Any suitable example such as:
   A contractor is contracted to build a strip foundation for a building. While the trenches are being dug, they discover an old septic tank that must be removed. The costs relating to the removal cannot be added to the original contract sum.
   – Extra work is work that falls outside of the original scope of the contract. The cost of doing extra work is carried by the client.
   Any suitable example such as:
   The foundation contractor is close to completing the project. The client then asks that a second foundation be built for a storeroom on the same premises. The costs related to this extra work will be added to the contract sum. (8)

4. A practical completion certificate is a formal document that signifies that the works, as set out in the contract, have been completed to such an extent that the client can safely use the works for its intended purpose. To get the practical completion certificate, the contractor must contact the engineer once they believe that the project is near completion and request the certificate. The engineer has 14 days to respond. Should the engineer feel that the project is not practically complete, a list that shows the outstanding tasks must be provided to the contractor. Once the tasks have been completed, the engineer will issue the certificate. After the certificate has been issued, the contractor still has time to complete the minor items and rectify the identified defects, as long as the client is not inconvenienced. (8)

5. Any suitable examples can be used.
   – Obvious defects: These defects are obvious to everyone involved.
   – Latent defects: These defects are hidden at first only to be revealed at a later stage. (4)

6. Any ONE of the following:
   – Breach of contract between the contractor and the client
   – Breach of contract between the contractor and subcontractor (1)

Total: 35 marks

Module summary

In this module, students learnt the following:

- The construction contract is a legally binding agreement between the parties based on the condition recorded in the contract document.
- Changes made to the scope of work set out in the contract are called variations.
- Variations are the result of the complexity of projects, as well as external factors that are beyond the contractor's control.
- Common factors that lead to variations include:
  - Design changes
  - Technological advancement
  - Statutory changes
  - Condition changes
  - Availability of materials.
- Variations provide some form of flexibility to the contractor.
- When variations do occur, it is important that they are added to the contract and that the project cost is adjusted accordingly.
- Unless the contractor agrees to it, variations cannot:
  - change the fundamental nature of the works originally agreed upon
  - omit work, just so that another contractor can carry it out
  - be made after the agreed upon work has been completed.
- Variations usually take the form of:
  - additional work, which is work that falls within the original scope of the contract and originates from the tasks which were originally contracted for
  - extra work, which is work that falls outside of the original scope of the contract
  - omissions, which is when a part of the originally agreed upon work is left out.
- When a client pays a contractor daily, it is referred to as day work.
- The day work payment method takes the following factors into account to determine the value of the work:
  - Time needed to complete the work
  - Materials required
  - Labour required
  - Equipment and machinery required.
- Day work is priced either by percentage addition or inclusive rates.

- The handover phase starts once the works are practically complete.
- Stakeholders prepare for handover by carrying out the following activities:
  - Testing and commissioning
  - Defect management
  - Compliance reporting.
- A practical completion certificate is a formal document that signifies that the works have been completed to such an extent that the client can safely use it for its intended purpose.
- The engineer issues the certificate to the contractor if the works have been completed to their satisfaction.
- After the certificate has been issued, the contractor still has time to complete minor items and rectify the identified defects without inconveniencing the client.
- A construction defect is when a part of the project, or the whole project, does not meet the specifications as set out in the contract, either in form or function.
- The two types of liability that arise from defects are:
  - breach of contract between the contractor and the client
  - breach of contract between the contractor and subcontractor.
- The two types of construction defects are:
  - obvious defects
  - latent defects.

MODULE

8 *Statutory bodies*

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

- explain the need for building regulations in terms of:
  - control
  - standardisation
  - quality
  - the built environment;
- explain the importance of adhering to the regulations and processes of the following:
  - regulatory bodies
  - trade organisations; and
- explain the importance of adhering to labour acts.

In this module, students learnt about the need for building regulations, the different types of regulatory bodies and the role labour laws play in the construction industry.

Exercise 8.1 SB page 151

1.1 False. SABS used to regulate the standards industry in South Africa until the regulation function and standardisation function was separated.
1.2 True.
1.3 True.
1.4 False. The main goal of the SACPCMP is to protect the public interest and improving construction and project management education.
1.5 False. The municipality is responsible for the administration of the National Building Regulations and control all on-site construction activities through inspections. (5 x 2)

2. Construction Industry Development Board (1)

3. – The CIDB sets national standards for construction contracts and delivery by standardising the construction procurement based on best practice
   – It keeps a national register of contractors and projects
   – It also focuses on:
      » uniformity in construction procurement
      » efficient and effective infrastructure delivery
      » construction industry performance improvement
      » industry transformation and skills development. (6)

4. Builders who deliver:
   – substandard houses
   – bad workmanship
   – poor quality material (3)

5. The difference is that regulatory bodies address issues from a public protection perspective, whereas trade organisations address issues from the needs of their members. (2)

6. Any TWO of the following:
   – Master Builders South Africa
   – South African Forum of Civil Engineering Contractors (SAFCEC)
   – Electrical Contractors Association South Africa (ECA-SA)
   – Constructional Engineering Association (CEA-SA)
   – Association of South African Quantity Surveyors (ASAQS)
   – Small Contractors Association of South Africa (2)

7. Any relevant answer:
   – Building, Construction and Allied Workers' Union (BCAWU)
   – Building, Wood & Allied Workers Union of South Africa (BWAWUSA)
   (1)

Total: 25 marks

Exercise 8.2 SB page 155

1.1 Labour law
1.2 South African Qualifications Authority Act or SAQA
1.3 Occupational Health and Safety Act or OSHA
1.4 Compensation for Occupational Injuries and Diseases Act or COIDA
1.5 Skills Development Act or SDA

2. Any FIVE of the following:
   - Employees receive a fair wage.
   - Employees have job security.
   - Employees have regulated breaks and work hours.
   - Labour unrest is minimised.
   - Better working conditions are promoted.
   - Victims of on-duty accidents get adequate compensation.
   - Strikes and conflicts are reduced. (5)

3. Depending on the specific act that is not complied with, penalties can be anywhere between R1.5 million and up to 10% of an employer's annual turnover. (2)

4. The purpose of the UIF is to provide short-term financial relief to workers who are unemployed or cannot work because of maternity leave or illness. (2)

5. To fund the skills development scheme as set out in the SDAs (1)

Total: 15 marks

Summative assessment SB page 158

1.1 B. National Building Regulations
1.2 C. Regulatory body
1.3 D. NHBRC
1.4 A. SANS
1.5 C. OSHA
1.6 B. Skill Development Levies Act
1.7 D. All of the above.
1.8 B. SABS
1.9 A. ECSA
1.10 C. Construction Industry Development Board (10)

2.1
- Registering persons as professionals in specified categories
- Regulating of the relationship between the South African Council for the Quantity Surveying Profession and the Council for the Built Environment
- Establishing and enforcing a professional code of conduct to protect the public from unethical behaviour from within the quantity surveying profession. (3)

2.2
- Certification
- Testing
- Consignment inspection (3)

2.3 – Imposing requirements, conditions and restrictions (3)
– Setting standards for activities
– Enforcing the regulations and gets people to comply. (3)

2.4 – Leave
– Work hours
– Severance pay and termination
– Variations to the Act by agreement. (4)

2.5 Any TWO of the following:
– Members of the National Intelligence agency, SA Secret Service and SA National Academy of Intelligence
– Unpaid volunteers
– The directors and staff of Comsec. (2)

2.6 – To improve the quality of life of the workers
– To improve productivity in the workplace
– To increase the levels of investment in education and training in the labour market
– To promote self-employment
– To improve the delivery of services (5)

Total: 30 marks

Module summary

In this module, students learnt the following:

- Building regulations are principles, rules, or laws used to control or govern the behaviour within the construction industry.
- The National Building Regulations set minimum standards for construction, and other safety protocols that apply to every structure that is erected.
- A standardised built environment ensures that every structure is sturdy enough to withstand the conditions in which it is built and can support the specific weight for its intended use.
- Standards are used as a basis to conduct construction inspections.
- A regulatory body is a public organisation or government agency that regulates the specific industry they are in.
- The main purpose of a regulatory body is to ensure the safety of the public by:
  - imposing requirements, conditions, and restrictions
  - setting standards for activities
  - enforcing the regulations and getting people to comply.

- A regulatory body is created based on legislation, and is funded by levies from the respective professions.
- The regulatory bodies in the construction industry include the following:
  - CIDB
  - NHBRC
  - SACPCMP
  - ECSA
  - SACAP
  - SACQSP
  - SABS
  - SANS.
- A trade organisation creates an environment where the specific trade can be held to a standard and level of quality.
- Trade organisations relevant to the construction industry in South Africa include:
  - Master Builders South Africa
  - South African Forum of Civil
  - Engineering Contractors (SAFCEC)
  - Electrical Contractors Association South Africa (ECA-SA)
  - Constructional Engineering Association (South Africa)
  - Association of South African Quantity Surveyors (ASAQS)
  - Small Contractors Association of South Africa.
- Labour laws are designed to regulate the relationship between the employer and the employees or the employer and the trade union, while aiming to promote a productive and safe workplace.
- Adhering to the labour laws ensures the following:
  - Employees receive a fair wage.
  - Employees have job security.
  - Employees have regulated breaks and work hours.
  - Labour unrest is minimised.
  - Better working conditions are promoted.
  - Victims of on-duty accidents get adequate compensation.
  - Strikes and conflicts are reduced.
- Depending on the specific act that is not complied with, penalties can be anywhere between R1.5 million and up to 10% of an employer's annual turnover.
- Trade unions focus on the needs of the individual.
- The responsibilities of the unions are usually supported by legislation and regulated by statute.

- The three main trade unions in South Africa are:
  - Congress of South Africa Trade Unions (COSATU)
  - Federation of Unions of South Africa (FEDUSA)
  - National Council of Trade Unions (NACTU).
- The Building, Construction and Allied Workers' Union (BCAWU) and the Building, Wood & Allied Workers Union of South Africa (BWAWUSA) are two unions in the construction industry
- Labour laws consist of the following workplace laws:
  - Basic Conditions of Employment Act (BCEA)
  - Compensation for Occupational Injuries and Diseases Act (COIDA)
  - Employment Equity Act (EEA)
  - Labour Relations Act (LRA)
  - Occupational Health and Safety Act (OHSA)
  - Skills Development Act (SDA)
  - Skills Development Levies Act (SDLA)
  - South African Qualifications Authority Act (SAQA)
  - The Constitution (Bill of Rights)
  - Unemployment Insurance Fund (UIF).

Glossary

A

Act of God – a term used to describe events considered to be beyond human control, such as natural disasters

Additive – a small amount of a chemical or mineral substance, which may be powdered or liquid, that increases the life of the concrete, controls the setting and hardening of the concrete

Aggregate – granular materials such as sand, gravel, or crushed stone

B

Bitumen – a material that is produced by the distillation of crude oil, also known as asphalt

C

Cart – a small-wheeled vehicle used to transport coal

Charging device – moves or loads material into a batching device such as a hopper

Concave – a curve like the inner surface of a sphere

Concentric circles – circles that share the same middle point

Consecutive – following one after the other without interruption

Contingencies – a possible future emergency that may occur but is not intended

Contour lines – the lines on a map that joins all the points of equal elevation

Counterweight – a weight that is used to keep the crane in balance when it is carrying a load

Cross-section – a section formed by a plane cutting through the surface at a right angle

Cut and fill – the process of excavating material in one place and depositing it at another nearby place

D

Data services – systems that allow the transfer of electronic data in and out of the building such as telephone services and internet connections

Deliverable – a tangible end product as a result of construction activity

Dispute – a disagreement or argument between two parties

E

Elevation line – the horizontal surface height

F

Fly ash – fine ash particles carried into the air when a solid fuel, such as coal, is combusted.

Formation level – the levelling or level surface required to build a structure on a slope without stilts or piers

G

Geological survey – an examination of an area to determine the character, relations, distribution, and origin or mode of formation of the rock masses and mineral resources

H

Hopper – a container that can empty from the bottom and is used for pouring material into a machine or bin

Hydrographical – refers to the physical features of bodies of water.

I

Inclusive rates – rates that include an allowance for overheads and profit for a fixed period

Industrial internet of things (IIoT) – the application of IoT technology in the industrial sector

In-house work – conducting an activity or operation within a company, instead of outsourcing it

Internet of things (IoT) – the network of physical objects or things, that are embedded with sensors, software and other technologies that is used to connect and exchange data with other devices and systems over the internet

Interval distance – the uniform space between cross sections

J

Jib – the horizontal or near-horizontal beam, also called the boom, of the crane that is used to support the load

Joinery – making and installing non-structural timber, timber composite, or metal components or elements for buildings; in its simplest and most traditional sense, joiners 'join' wood in a workshop, whereas carpenters construct the building elements on site

L

Lattice boom – a boom where some of its structural components are arranged in a crossing pattern

Legislation – a set of laws that are set by the government, such as the various labour acts

Liaison – someone who facilitates communication and cooperation between two parties to improve their working relationship

Lobbying – to lobby is to seek to influence (a legislator) on an issue

Luff – the action of raising and lowering the boom of the crane

M

Mass haul diagram – a graphical view of the volume of material moved

Mock-up – a scale or full-size model of a design used for demonstration, design evaluation, promotion, and other purposes

N

Non-disclosure agreement – a binding contract between two or more parties that prevents sensitive information from being shared with any others

O

Ore – a mined organic material from which a valuable part such as metal can be extracted for a profit

Outrigger – an extendable supporting device used to level the crane and increase its stability

Overheads – expenses related to operating a business

P

Parabola – an algebraical U-shaped curve

Preliminary – the first survey that started the process
Perpendicular – at an angle of 90° to a given line, plane, or surface

R

Ravines – a deep narrow valley that is formed by running water

Racking – when the load is moved horizontally via a trolley running along the jib of the crane

S

SETA – an acronym for the Sector Education Training Authorities

Sheave – a wheel with a grooved rim on which a rope runs

SHERQ – an acronym for safety health, environment, risk and quality management

Shoring – a system that is used to prevent trench collapse

Silica fumes – also known as micro silica; an ultrafine powder collected as a by-product of silicon and ferrosilicon alloy production

Sinkhole – a hole formed in underlying rock by water, causing the surface to collapse

Slag – the residue of the metallic ore smelting process

Slew – the rotation of the boom around a central axis

Statute – a written law passed by a body of legislature; also known as an *act*

T

Telescopic boom – a boom that consists of movable sections that allow the boom to extend or retract

Test boring – the process of sinking (boring) holes into the ground to get samples from which information on the characteristics of the ground can be obtained

W

Weigh batcher – a batching plant in which all ingredients for a concrete mix are measured by weight