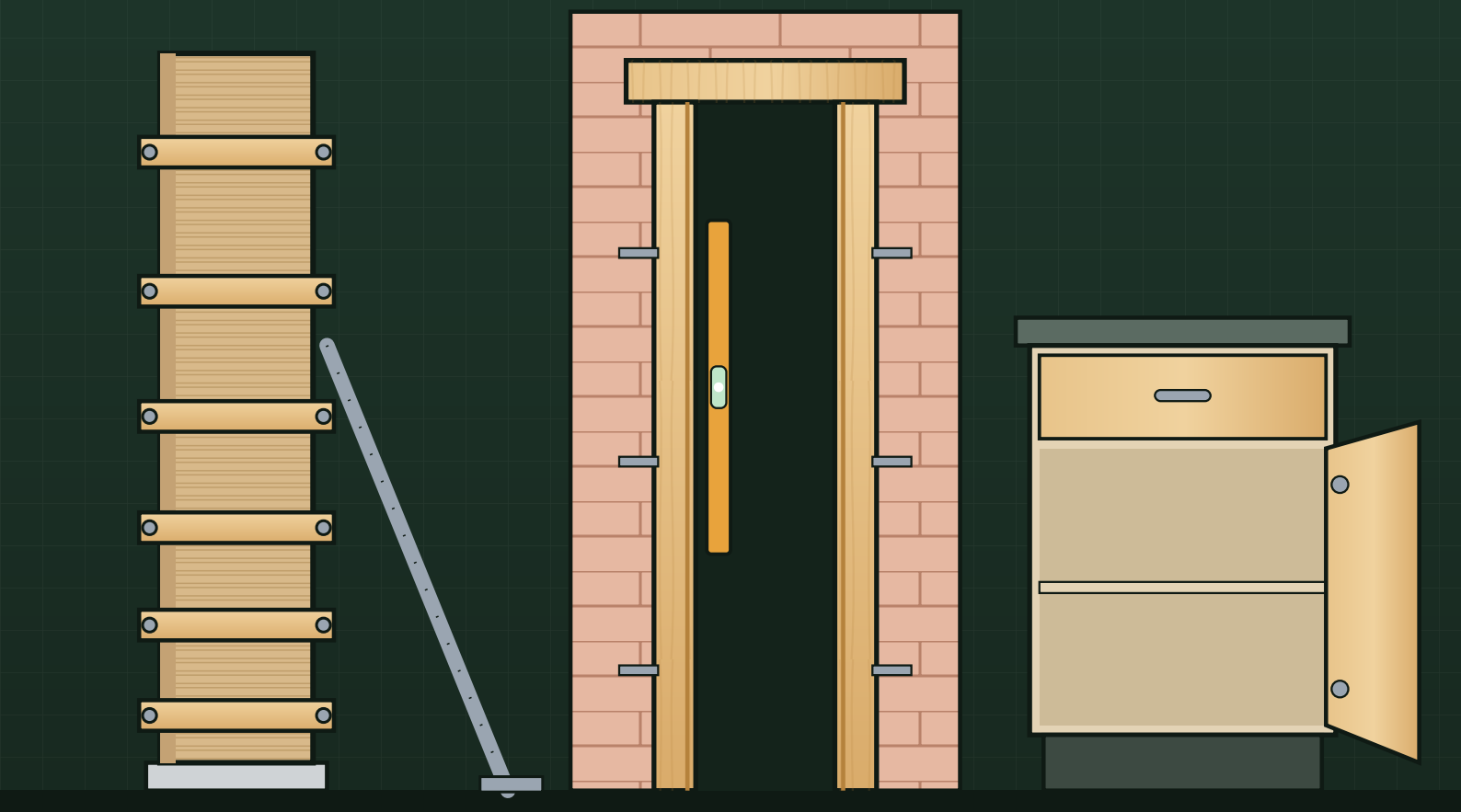
KNQF LEVEL 3 · TVET CDACC CYCLE 3

Carpentry and Joinery

Level 3 · A Practical Study Guide for Kenyan Trainees

Temporary works · Door and window frames · Cabinetry works



Green Skills Edition

Reusable formwork · legal timber · low-VOC finishes · less waste

Alphonce Kimutai Kirui

Aligned to the TVET CDACC Competency-Based Modular Curriculum, Carpentry and Joinery KNQF Level 3

Carpentry and Joinery Level 3

A Practical Study Guide for Kenyan Trainees

Temporary Works · Door and Window Frames · Cabinetry Works
Kenya National Qualifications Framework (KNQF) Level 3 · Green Skills Edition

Alphonce Kimutai Kirui

Carpentry and Joinery Level 3: A Practical Study Guide for Kenyan Trainees
First edition, October 2026

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Published by the author. Website: alphoncekirui.com

About the curriculum

This book is an independent study guide. It follows the topics and units of the TVET CDACC Competency-Based Modular Curriculum and Occupational Standard for Carpentry and Joinery, KNQF Level 3 (Cycle 3, greened version, programme code 0732 454 B, unit codes CON/CU/CAJ/CR/01–03/3/MB). Unit titles and codes are used for reference only. The book is not published, endorsed or approved by TVET CDACC, TVETA or the Ministry of Education. Always follow the current official curriculum and your trainer's guidance.

Safety and accuracy notice

Building sites and joinery workshops have serious hazards: deep trenches, collapsing formwork, heavy lifting, falling objects, sharp tools, power tools, dust, noise and chemicals. The methods in this book are for training under the supervision of a qualified trainer and, on site, a competent supervisor or engineer. Figures given as "typical" (trench support spacings, formwork member sizes, prop spacings, striking times, fixing spacings, tolerances, cabinet dimensions and prices) are general guidance only. Always follow the drawings, the engineer's or supervisor's instructions, the manufacturer's instructions, the Occupational Safety and Health Act 2007 and the relevant Kenyan standards and building code. Prices are approximate (2026) and vary by town and season.

Names of people, companies and places used in examples are made up for teaching.

Illustrations

All drawings and diagrams in this book were drawn for it. They are teaching drawings and are not to scale unless a scale is shown. Always work from the real drawings and measurements for your job.

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How to use this book

This book follows the Carpentry and Joinery Level 3 course from start to finish. It covers the three core units and the industrial training, in the same order as your training. You can read it cover to cover, or study one unit at a time if you are taking a part qualification.

The course at a glance

Part	What it covers	Training time
1. Getting started	The trade, the course and assessment, safety, timber and boards, tools, drawings and setting out, joints and fixings (the shared basics of every unit)	Used throughout
2. Temporary works	Unit 1: Temporary Works (CON/CU/CAJ/CR/01/3/MB)	130 hours
3. Door and window frames	Unit 2: Door and Window Frames (CON/CU/CAJ/CR/02/3/MB)	100 hours
4. Cabinetry works	Unit 3: Cabinetry Works (CON/CU/CAJ/CR/03/3/MB)	120 hours
5. Industrial training and assessment	Industrial training, starting out in business, and getting ready to be assessed	240 hours

What is in each chapter

- **What you will learn:** the chapter's goals, with the unit, learning outcome and training hours it belongs to.
- **Key words:** the trade words you need, explained simply. More are in the Glossary at the back.
- **Explanations and drawings:** each topic explained step by step, with labelled diagrams, sections and step-by-step drawings.
- **Worked examples:** measurements, timber and board quantities, unit conversions and costings worked through with real numbers.
- **Practical tasks:** workshop and site jobs with the tools, materials, steps and safety points. Do them with your trainer.
- **Check your competence:** a checklist of what an assessor will expect you to show. Tick each item when you can do it without help.
- **Practice questions:** answers are at the back of the book.

Look out for these boxes

> **SAFETY FIRST**
>
> Hazards and how to stay safe. Never skip these.

> **GREEN TIP**
>
> Ways to save timber, boards, energy and money, to repair rather than replace, and to handle waste correctly. Green skills are part of your assessment.

TRAINER'S TIP

Advice from experienced trainers and fundis to help you work faster and better.

COMMON MISTAKES

Errors trainees often make, and how to avoid them.

ON THE KENYAN SITE

How the topic looks on real building sites, in joinery workshops and timber yards in Kenya.

Colours and lines in the drawings

The drawings use the same colours and line styles all through the book, so you can read any section or detail at a glance. The line styles are the same ones used on building drawings (see the Drawing symbols chart at the back).

Sawn timber (end grain darker, with growth rings)		Plywood and marine (shuttering) board	
MDF, chipboard and melamine board		Concrete	
Masonry and blockwork		Soil	
Steel props, ties, fixings and metal parts		Water	
Dimension lines and measurements		Centre lines (dash-dot, blue)	
Hidden lines (dashed)		Danger and warnings	

PART 1

Getting Started

What a Level 3 carpenter and joiner does, how you will be trained and assessed, and the shared basics of every unit: safety, timber and boards, tools, drawings and setting out, joints and fixings.

Chapter 1: Becoming a Carpenter and Joiner in Kenya
Chapter 2: Safety, Health and Housekeeping on Site and in the Workshop
Chapter 3: Timber and Manufactured Boards
Chapter 4: Hand Tools, Power Tools and Their Care
Chapter 5: Drawings, Measuring and Setting Out
Chapter 6: Woodworking Joints, Fasteners and Adhesives

CHAPTER 1

Becoming a Carpenter and Joiner in Kenya

WHAT YOU WILL LEARN

- What a Level 3 carpenter and joiner does on site and in the workshop.
- Where carpenters and joiners find work in Kenya, and how you can grow in the trade.
- How competency-based training (CBET) works: units, elements, performance criteria and certificates.
- How the 590-hour course is laid out and how you are assessed and rated.
- Where most of the marks are, so you know which skills to practise hardest.
- How a professional fundi behaves, and how to study well during the course.

Applies to: all three core units and industrial training · CON/CU/CAJ/CR/01–03/3/MB · Course orientation

Walk through any Kenyan town and you will see new buildings going up. Someone builds the timber boxes that hold wet concrete. Someone fixes the door and window frames. Someone fits the kitchen and wardrobes before the owner moves in. This book trains you to be that person.

Key words

Carpentry
Structural timber work done mainly on the building site, such as formwork and roofs.

Joinery
Finer timber work, usually made in a workshop, such as frames, doors and cabinets.

Fundi wa mbao
Swahili for a skilled timber worker; the everyday name for a carpenter or joiner.

Temporary works
Structures put up only to help build the permanent work, then removed, for example formwork and trench supports.

CBET
Competency-Based Education and Training: you are judged on what you can actually do to a set standard.

Unit of competency
One complete job area you can be trained, assessed and certified in, such as Cabinetry Works.

Element
A main part of a unit; a unit is broken into a few elements.

Performance criteria (PCs)
The checkable statements that say what "done well" looks like for each element.

Formative assessment
Assessment done during training to check progress and give feedback.

Summative assessment
Final assessment at the end of a unit that decides your result.

RPL
Recognition of Prior Learning: getting assessed and certified for skills you already have from work.

Portfolio of evidence
Your file of proof: marked tests, checklists, photos, drawings and mentor reports.

1.1 What a Level 3 Carpenter and Joiner Does

1.1.1 Carpentry and joinery: one trade, two sides

The two words are close, but not the same. **Carpentry** is the heavy, structural timber work done on site. The carpenter builds formwork for concrete, supports the sides of trenches, and fixes roof timbers. The work must be strong and safe, and is often taken down again.

Joinery is finer work. The joiner makes and fixes items that people see and touch every day: door and window frames, doors, cabinets, shelves and wardrobes. Joints must be tight, surfaces smooth and sizes exact to the millimetre. Much joinery is made in a workshop and then carried to site for fixing.

In Kenya most fundi do both. A contractor wants one person who can build column boxes in the morning and fix a door frame in the afternoon. Table 1.1 compares the two.

Table 1.1 Carpentry and joinery compared

Point	Carpentry	Joinery
Main place of work	Building site	Workshop, then site for fixing
Typical products	Formwork, trench supports, props, roof structures	Door and window frames, doors, cabinets, wardrobes
Timber used	Sawn cypress and pine, eucalyptus poles, shuttering plywood	Planed (wrought) softwood and hardwood, MDF, blockboard
Accuracy needed	Usually a few millimetres; strength and safety come first	About 1 mm; neat joints and a clean finish
Life of the work	Often temporary; taken down and reused	Permanent; stays in the building for years

1.1.2 The three core jobs at Level 3

The Level 3 qualification is built on three core jobs. Each one becomes a unit of the course, and each has its own part of this book (see Figure 1.1).

- **Temporary works.** You set out and build trench timbering to hold back the soil in excavations. You build formwork, the timber or plywood mould that gives wet concrete its shape. You fix shuttering, which is the sheet material that forms the face of the concrete. Later you take it all down safely and store it for reuse.
- **Door and window frames.** You prepare openings in walls, stand the frames in place, get them plumb (truly upright), level and square, then fix them firmly and finish them neatly.
- **Cabinetry works.** You set out and assemble cabinet units, then install kitchen cabinets, built-in cupboards and wardrobes so that they are level, square and work smoothly.

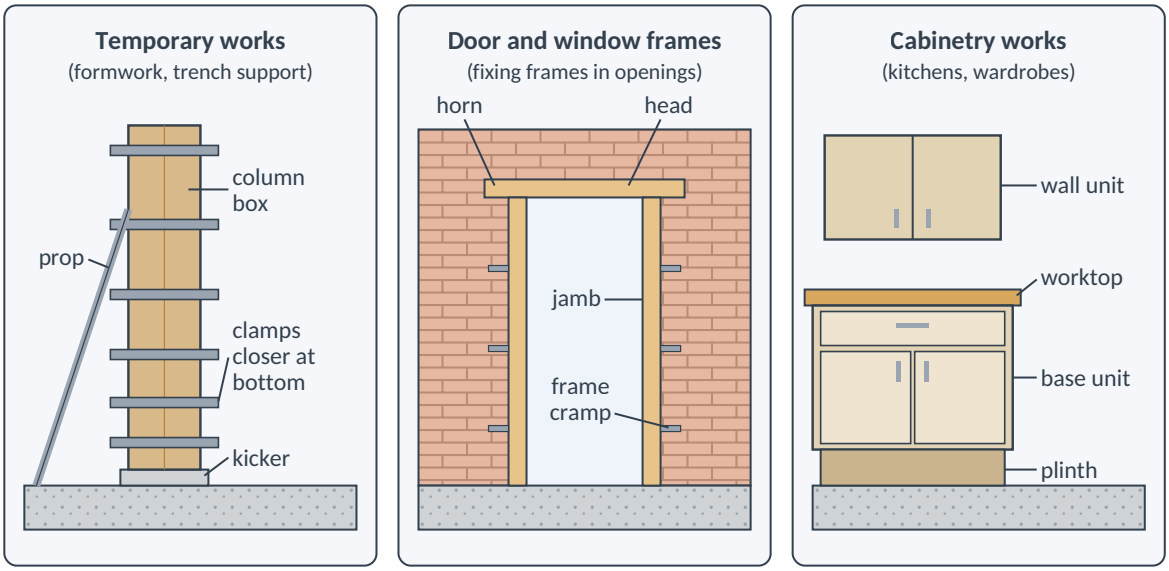


Figure 1.1 The three core jobs of a Level 3 carpenter and joiner: building temporary works such as a column box, fixing door and window frames, and installing cabinets.

1.2 Where Carpenters and Joiners Work

A trained carpenter and joiner can earn a living in many places. The main ones are:

- **Building contractors**, for formwork, frames and roofs, moving from site to site.
- **Joinery workshops**, which make frames, doors, kitchens and wardrobes to order and send fixers to site.
- **Furniture makers and jua kali workshops**, such as those at Gikomba, Kariokor and in most county towns.
- **Real-estate developers**, whose apartment blocks need hundreds of identical frames and kitchen units.
- **Public projects**: county and national schools, health centres, markets and the government Affordable Housing Programme sites.
- **Self-employment**: fitting kitchens, repairing doors and making wardrobes for your own clients.

Demand is steady because Kenya's towns are growing fast. Every new storey needs formwork, and every new flat needs frames, doors and a kitchen.

> **ON THE KENYAN SITE**
>
> Pay depends on the town, the contractor and your skill. As a rough guide, a skilled carpenter on a building site typically earns about KSh 1,500 a day, within a range of roughly KSh 1,000–2,500 (approximate, 2026), often paid weekly by M-Pesa. Fundi who read drawings and work accurately earn at the top of that range.

1.3 Your Career Path

1.3.1 The ladder

Level 3 is the first step, not the last. The Kenya National Qualifications Framework (KNQF) arranges qualifications in levels. Each higher level adds harder tasks, more planning and more responsibility. Figure 1.2 shows a typical path. Exact titles of the higher courses can change, so check them with your VTC.

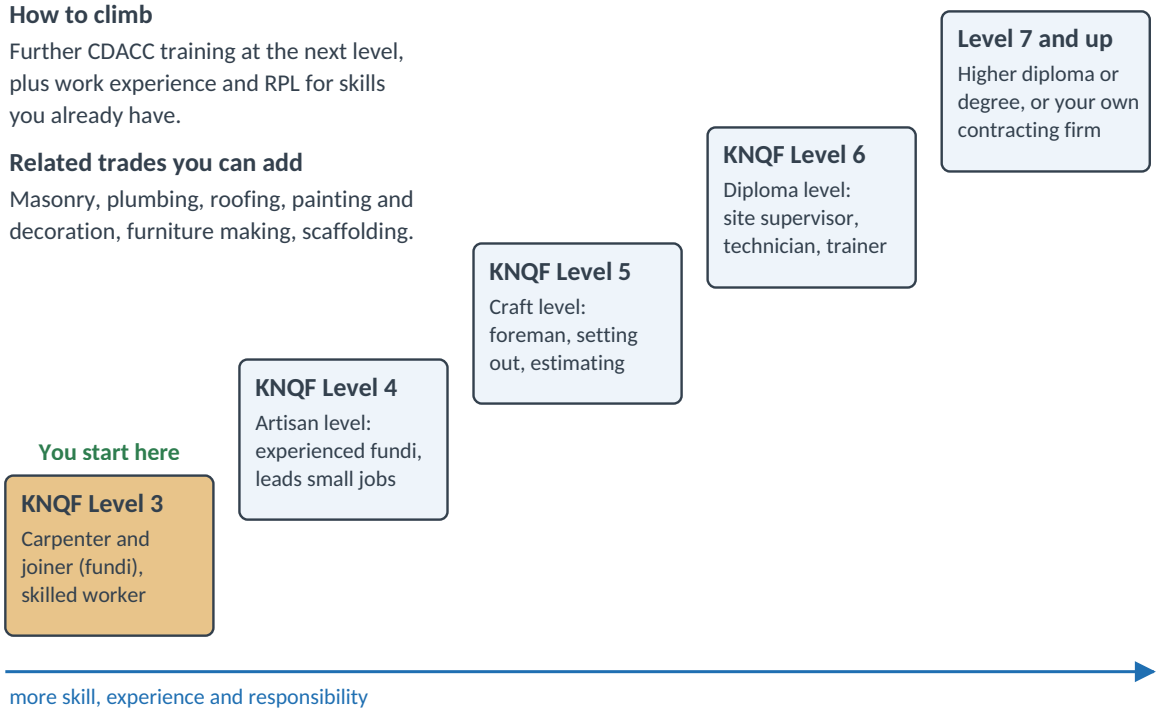


Figure 1.2 A typical career ladder. You climb by further training, work experience and RPL. Course titles above Level 3 vary; check with your VTC.

1.3.2 Registration with the National Construction Authority

The National Construction Authority (NCA) regulates the construction industry in Kenya. It runs a scheme to register and accredit skilled construction workers, including carpenters. On bigger sites the main contractor may ask to see your NCA card before you start work. Your Level 3 certificate is strong evidence of your skill when you apply. Steps and fees change, so get current details from NCA (see Chapter 17).

1.4 How Competency-Based Training Works

1.4.1 Learning by doing, to a standard

This course follows Competency-Based Education and Training (CBET). The question is simple: *can you do the job, safely, to the standard the industry expects?* If yes, you are competent. If not yet, you practise and try again.

The standard comes from the **occupational standard** for Carpenter and Joiner Level 3. Employers and trainers wrote it together to describe real work. The CDACC curriculum turns it into lessons and practicals.

1.4.2 The building blocks

- **Unit of competency.** A complete job area, for example Door and Window Frames.
- **Learning outcome (LO).** A main thing you must learn inside a unit, with a set number of hours. In the curriculum each LO matches an element of the standard.
- **Element.** A main part of the job. Fixing frames, for example, has elements for preparing the opening, positioning and securing the frame, fixing, and finishing.

- **Performance criteria (PCs).** Short, checkable statements under each element. An assessor watches you and ticks each one. For example: “the frame was checked for plumb, level and alignment before final fixing.”
- **Range.** The list of variations you must handle, such as different soil types, frame materials or fixing methods.
- **Required knowledge.** The theory behind the work.

1.4.3 Certificates and RPL

CBET lets you build a qualification piece by piece. Table 1.2 shows what you can earn; TVET CDACC issues all of them.

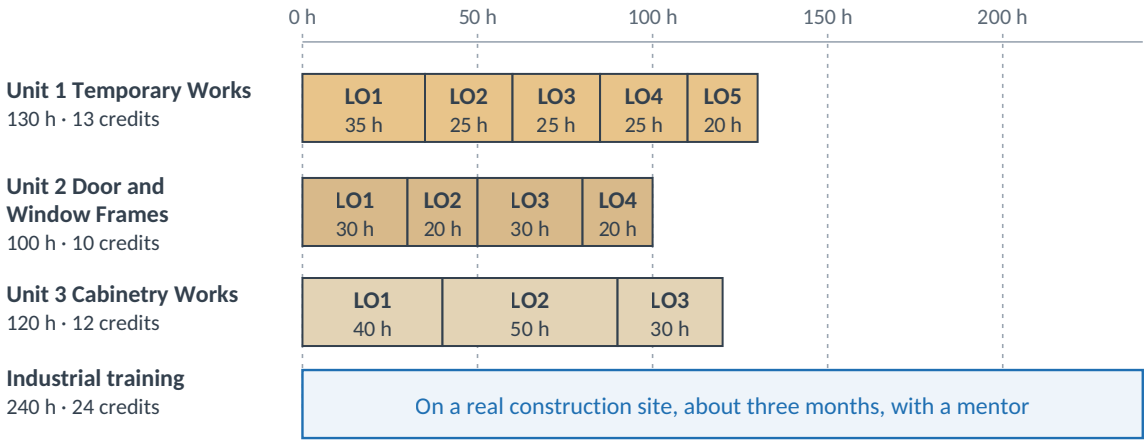
Table 1.2 Certificates you can earn in this qualification

Certificate	What you must show	Example
Statement of Attainment	Competence in a certifiable element within a unit	You pass the trench timbering part of Temporary Works
Certificate of Competency	Competence in one whole core unit	You pass all of Cabinetry Works
Kenya National TVET Certificate in Carpentry and Joinery Level 3	Competence in all the units of the qualification	You pass all three core units

Recognition of Prior Learning (RPL) is for people who already do the work. Many fundi learned on the job. Through RPL they are assessed against the same standard and can receive a part or full qualification.

1.5 The Course Map

The course has three units taught at the VTC, then industrial training on a real site. Figure 1.3 shows the hours. One credit equals ten hours of learning, so the credits follow directly from the hours.



Total: 350 h of units + 240 h industrial training = 590 h = 59 credits (1 credit = 10 hours)

Figure 1.3 The course map. Each unit is split into learning outcomes (LO); bar lengths are drawn to scale in hours.

Table 1.3 Units and learning outcomes, with the chapters of this book

Unit and code	Learning outcomes (hours)	Book chapters
Unit 1 Temporary Works CON/CU/CAJ/CR/01/3/MB 130 h, 13 credits	LO1 Set out and prepare for temporary works (35) LO2 Install trench timbering (25) LO3 Construct and erect formwork (25) LO4 Install and secure shuttering (25) LO5 Dismantle and remove temporary works (20)	Part 2
Unit 2 Door and Window Frames CON/CU/CAJ/CR/02/3/MB 100 h, 10 credits	LO1 Set out and prepare openings (30) LO2 Position and secure frames (20) LO3 Apply fixings and reinforcements (30) LO4 Finish and inspect frames (20)	Part 3
Unit 3 Cabinetry Works CON/CU/CAJ/CR/03/3/MB 120 h, 12 credits	LO1 Set out and prepare work area (40) LO2 Assemble and prepare cabinet units (50) LO3 Install built-in cabinets, kitchen cabinets and wardrobes (30)	Part 4
Industrial training	240 h on a construction site, with a mentor	Chapter 17

Part 1 of this book (Chapters 1 to 6) covers skills shared by all three units: safety, timber, tools, drawings and setting out, and joints.

Entry. To join the course you need the Kenya Certificate of Primary Education (KCPE) or an equivalent qualification accepted by the TVET Authority (TVETA).

Industrial training. You spend at least 240 hours working on a real construction site. Full-course trainees usually go after all three units; part-qualification trainees may split the time across units. A mentor at the workplace guides you for at least three months. The mentor assesses you three times, once in each month, and the last assessment is the one that counts. At least two thirds of your time should be spent on temporary works, door and window frames and cabinetry. Your worker behaviour is rated too (see Chapter 17).

1.6 How You Are Assessed

1.6.1 Formative and summative assessment

You are assessed in two ways (see Figure 1.4). **Formative assessment** happens during training. Your trainer checks every performance criterion through practical tasks, oral questions and short written tests. It shows you what to improve. **Summative assessment** comes at the end of a unit. It is mainly practical and looks hardest at the critical aspects of that unit, the skills that make the work safe and sound. For theory (written and oral) work, formative marks count for 60% and summative marks for 40% of the theory score.

1.6.2 Theory and practical

You may hear two different splits between theory and practical. The curriculum sets a 30:70 theory-to-practical split; the CDACC performance-criteria weighting tables give most marks (90 of 100) to practical performance criteria. Either way, practical competence decides your result — check the current split with your assessor.

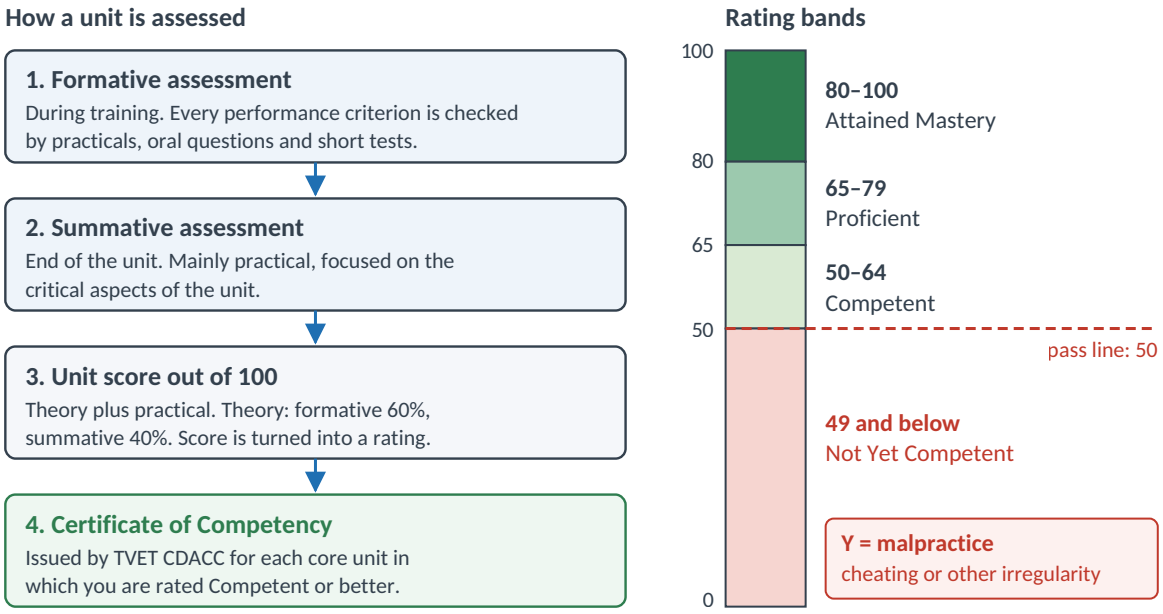


Figure 1.4 The assessment route for each unit, and the rating bands used to turn your score into a result.

1.6.3 Ratings

Your score for each unit is turned into a rating, as shown in Figure 1.4. A score of 50 or more makes you competent. Higher scores show employers that you are proficient or have attained mastery. A score of 49 or below means Not Yet Competent: you get more practice and are assessed again. The letter "Y" is recorded for malpractice, such as copying, using someone else's work, or getting help you are not allowed. It can cost you the whole unit. Never risk it.

Assessment takes place on the job or in a workshop that copies real site conditions. Each piece of evidence goes into your **portfolio of evidence**, so keep your work neat and dated.

1.6.4 Worked example: from marks to a rating

Wanjiru is assessed in Door and Window Frames using the CDACC weighting tables (theory 10 marks, practical 90).

1. Theory: she scores 7 out of 10.
2. Practical: she scores 61 out of 90.
3. Unit score: 7 + 61 = 68 out of 100.
4. Rating: 68 lies in the 65–79 band, so she is rated **Proficient**.
5. Check: what if she had scored only 40 out of 90 in the practical? 7 + 40 = 47, which is Not Yet Competent. Good theory cannot rescue weak practical work.

If your assessor uses the 30:70 split instead, the arithmetic changes but the rating bands stay the same.

1.7 Where the Marks Are

Not every element carries the same weight. Figure 1.5 shows how the CDACC weighting tables share the 100 marks of each unit between its elements. Study it before each unit, and plan your practice time around it.

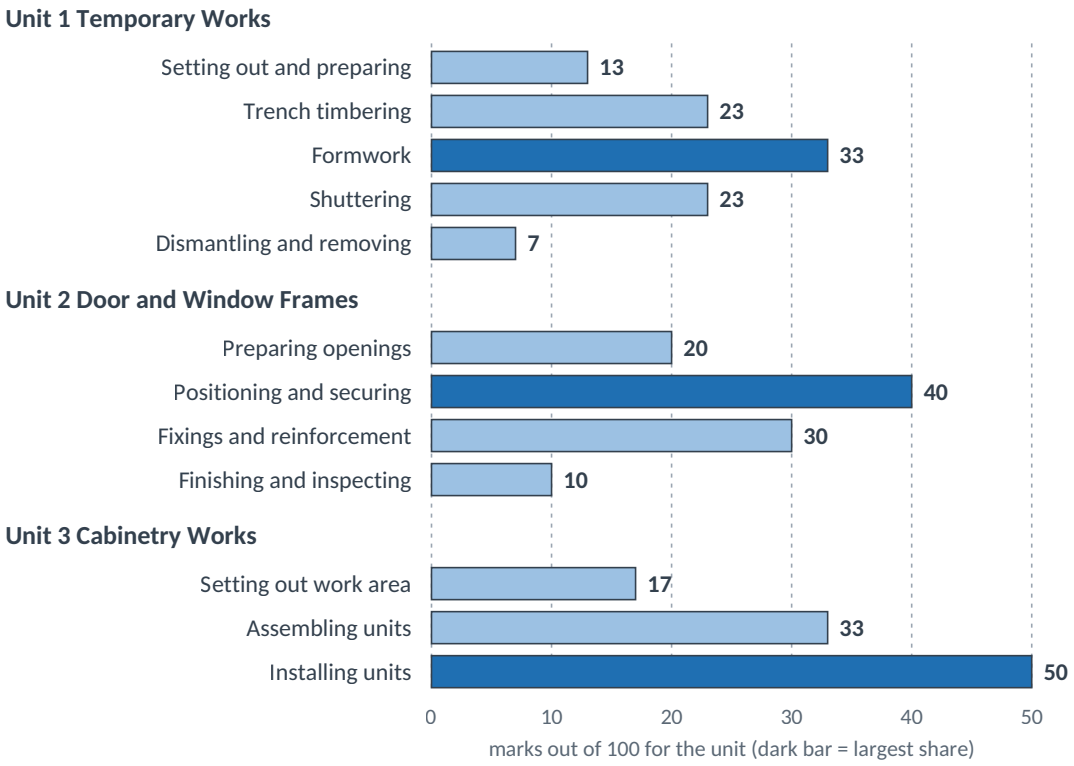


Figure 1.5 Marks per element in each unit, from the CDACC performance-criteria weighting tables. Formwork, positioning and securing frames, and installing cabinets carry the most.

Three lessons stand out:

- **Temporary works:** formwork carries a third of the marks; getting its sizes right and erecting it to suit the element are the heaviest criteria. (The printed table for this unit adds to 99, not 100; ask your assessor how the last mark is handled.)
- **Door and window frames:** positioning and securing is worth 40 marks. Checking plumb, level and alignment, temporarily securing the frame with wedges and clamps, and installing the fixings carry 12 marks each.
- **Cabinetry:** half the marks are for installation: fixing built-in parts, building the built-in frame, fitting doors, shelves and drawers, and pre-drilling hardware holes.

> **TRAINER'S TIP**
>
> “Plumb, level and square” appears again and again in the heaviest criteria. Check with the spirit level and measure diagonals before every fixing, from your first week.

1.8 Professional Conduct

1.8.1 How a good fundi behaves

Skill alone does not keep you employed. During industrial training your mentor also rates your behaviour, looking for qualities such as:

- **Communication and teamwork.** Listen to instructions, ask when unsure, and work well with masons, steel fixers and other trades.

- **Honesty and trust.** Look after the client's materials and tools. Report mistakes early instead of hiding them.
- **Respect and tolerance** for people of every background.
- **Diligence and time keeping.** Arrive on time, finish what you start and check your own work.
- **Openness to correction.** Accept feedback calmly.
- **Care for the environment.** Waste less timber, sort offcuts and keep the site clean.
- **Presentation and discipline.** Wear clean PPE, follow site rules and keep your tools in order.

1.8.2 A day on site

Figure 1.6 follows a typical day on a Kenyan building site. It starts and ends with safety and housekeeping.

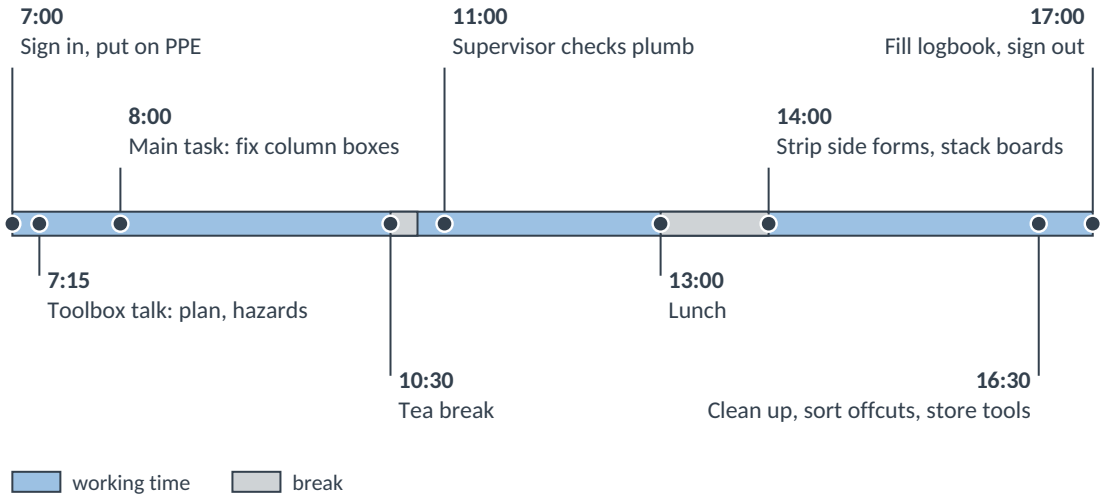


Figure 1.6 A typical day on site. Safety briefing, checking and clean-up are part of the job, not extras.

SAFETY FIRST

From your very first day in the workshop or on site: wear your safety boots and the PPE the task needs, never use a power tool you have not been shown how to use, never enter a trench or climb formwork without permission, and report every injury, even a small cut. Kenya's Occupational Safety and Health Act 2007 puts duties on both employers and workers, and the Directorate of Occupational Safety and Health Services (DOSHS) enforces it. Chapter 2 covers safety in full.

GREEN TIP

This is a "greened" course. For a carpenter that means buying legally sourced timber (for example from Kenya Forest Service plantations), reusing formwork and props many times, using cutting lists so less timber is wasted, keeping offcuts for small parts, and giving sawdust and shavings a second life as briquettes or animal bedding. Green habits also save money.

1.9 Studying Well

These habits help you learn well:

- **Keep a sketchbook.** Draw every joint, frame and form you make, with sizes.
- **Practise the basics daily.** Ten minutes of sawing to a line or planing square every day beats two hours once a week.
- **Learn the trade words** from each chapter's key-word list and use them on site.
- **Do the sums yourself:** inches to millimetres, running metres, pricing a job.
- **Watch and ask** experienced fundi why they do things, not only how.
- **Build your portfolio as you go:** dated photos, marked tests and checklists.

COMMON MISTAKES

- Ignoring theory. You need it to read drawings, calculate materials and answer oral questions.
- Rushing to finish instead of checking plumb, level and square. Speed comes later; accuracy earns marks now.
- Losing evidence. Missing photos, checklists or mentor reports can delay your certificate.
- Treating industrial training as free time. Your mentor's final report counts.

Practical task 1.1: Visit a carpentry and joinery workplace

Tools and equipment

- Notebook and pencil
- Phone camera (only with permission)
- Steel tape (5 m)
- Full PPE: helmet, boots, reflective vest

Materials

- Introduction letter from your VTC
- Question sheet prepared in class
- Simple table for recording tools, materials and tasks

Steps

1. With your trainer, choose a building site or joinery workshop near the VTC and arrange the visit.
2. On arrival, report to the site office, sign in and attend any safety briefing.
3. Watch the carpenters and joiners at work. List each task you see under one of the three units: temporary works, frames, or cabinetry.
4. Record the tools, timber sizes and board materials in use. Note which items are being reused.
5. Ask one fundi how they learned the trade and which skill they use most.
6. Note any safety and housekeeping practices you see, good or bad, without naming individuals.
7. Write a one-page report and a sketch of one item of temporary works or joinery you saw. File it in your portfolio of evidence.

Safety

- Stay with your group and the person guiding you; never wander into work areas alone.
- Keep clear of trenches, edges, formwork under load and moving machinery.

- Do not touch tools or materials unless invited and supervised.

Chapter summary

- Carpentry is structural site work; joinery is finer, often workshop-made work. A Level 3 fundi does both.
- The three core jobs are temporary works, door and window frames, and cabinetry works.
- Work comes from contractors, joinery workshops, jua kali, developers, public projects and self-employment.
- Level 3 is the first step on a ladder of higher qualifications; NCA runs registration for skilled workers.
- CBET judges what you can do against performance criteria; certificates can be earned per element, per unit or for the full qualification, and RPL recognises existing skill.
- The course is 130 + 100 + 120 hours of units plus 240 hours of industrial training: 590 hours, 59 credits.
- Scores of 50 and above are competent; practical work carries most of the marks, especially formwork, securing frames and installing cabinets.
- Good behaviour, safety, green habits and steady study are part of being competent.

Check your competence

- [ ] I can explain the difference between carpentry and joinery with examples.
- [ ] I can name the three core units and say what work each one covers.
- [ ] I can list at least five places where a carpenter and joiner can find work in Kenya.
- [ ] I can explain unit, element, performance criteria and range in my own words.
- [ ] I can name the certificates available and explain what RPL is.
- [ ] I can state the course hours and credits and work out credits from hours.
- [ ] I can turn a unit score into the correct competence rating.
- [ ] I can name the elements that carry the most marks in each unit.
- [ ] I can describe how a professional fundi behaves on site.

Practice questions

1. Give two differences between carpentry and joinery, with one product of each.
2. Name the three core units of Carpentry and Joinery Level 3 and give one task from each.
3. What is temporary works? Give two examples.
4. Explain the meaning of “performance criteria” and give one example from fixing door frames.
5. What is the difference between a Statement of Attainment and a Certificate of Competency?
6. (Oral) Explain to an experienced fundi who has no certificate how RPL could help him.
7. Calculation: the three units total 350 hours. If your VTC timetable gives 25 hours of training per week, how many weeks will the units take? How many credits do the units and industrial training give in total?
8. Calculation: a trainee scores 6 out of 10 in theory and 58 out of 90 in practical for Cabinetry Works. Find the unit score and the rating.

9. In Cabinetry Works, installation carries 50 marks and setting out 17. What percentage of the unit's marks comes from the other element, assembling units?
10. Practical: visit a workshop or site (Practical task 1.1) and present a short oral report to your class on the work you saw, sorting each task under one of the three units.

CHAPTER 8

Trench Timbering for Excavation Support

WHAT YOU WILL LEARN

- Explain why trenches collapse and judge when a trench needs support.
- Name the parts of trench timbering and choose materials, tools and equipment for the job.
- Install open timbering and close sheeting from the top down, secured and braced to suit the soil.
- Provide safe access, edge protection and set-back for spoil and plant.
- Inspect, maintain and later remove trench supports safely, and keep the site clean.
- Work out the boards, walings, struts and cost for a supported trench.

Unit: Temporary Works · CON/CU/CAJ/CR/01/3/MB · Learning outcome 2 · About 25 hours

Foundations, sewer lines, water pipes and power cables all start with a trench. A trench looks harmless, but its sides can fall in without warning and bury a worker in seconds. The carpenter holds those sides back with timber or steel so that the people below can work safely.

Key words

Excavation
Any hole, pit or trench dug in the ground.

Trench
A long, narrow excavation, usually deeper than it is wide.

Trench timbering
The temporary timber (or steel) supports that hold trench sides in place.

Poling board
A short, vertical board placed flat against the trench wall.

Sheeting
Vertical boards placed edge to edge so that no soil can run through.

Waling (waler)
A horizontal timber running along the trench that holds the boards against the wall.

Strut
A horizontal member across the trench that pushes the two walings apart.

Folding wedges
A pair of tapered timber pieces driven against each other to tighten a strut.

Lip block
A small block nailed on the end of a strut so it cannot drop off the waling.

Puncheon
A short vertical timber between two walings that carries the lower one.

Spoil
The soil dug out of the trench and heaped on the ground.

Surcharge
Extra load near the trench edge, such as spoil, materials or vehicles, that pushes the sides in.

8.1 Why Trenches Collapse

Digging a trench removes the soil that was holding the sides up. Sooner or later, gravity wins. One cubic metre of soil weighs about 1.5 to 2 tonnes, so even a small fall can crush a person's chest or trap their legs.

8.1.1 Soil types and how they behave

Different soils fail in different ways (see Figure 8.1 and Table 8.1). Recognise the soil before you choose the support, and look at it again each day.

- **Rock** – hard ground that needs breaking. It usually stands well, but loose blocks and cracked layers can still fall.
- **Firm soil** – stiff clay, murram and compact earth. It stands for a few hours or days, then cracks behind the edge and falls in as slabs.
- **Loose soil** – dry sand, gravel and made-up ground (fill). It will not stand upright at all. It runs down until it reaches a gentle slope.
- **Waterlogged soil** – any soil below the water table or soaked by rain. Water makes the grains slide easily, flows into the trench and can lift the trench floor.

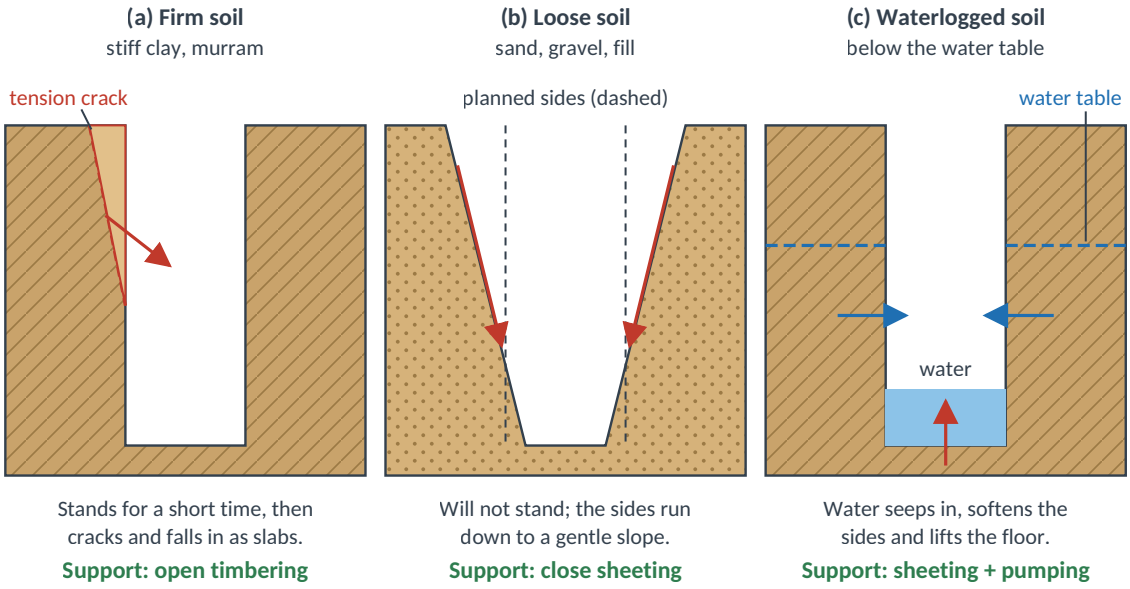


Figure 8.1 How three soil types fail when a trench is left unsupported, and the usual support for each.

8.1.2 Water, vibration and surcharge

Soil type is only part of the story. Three other things make a trench much more dangerous:

- **Water.** Rain, a burst pipe or a high water table softens the sides. A trench that stood well yesterday can fail the morning after a heavy storm.
- **Vibration.** A compactor, a passing lorry, a concrete mixer or a breaker shakes the soil grains loose.
- **Surcharge.** Anything heavy near the edge adds load and pushes the side inwards. Spoil heaps, stacks of blocks, a parked tipper or an excavator are common causes.

8.1.3 When a trench needs support

As a working rule, any trench deeper than about 1.2 m must be supported, or its sides cut back to a safe slope (battered). A shallower trench in loose or wet ground may also need support. The Occupational Safety and Health Act 2007 places the duty on the employer to keep excavations safe, and DOSHS inspectors check this on site. The drawing, engineer or supervisor decides the method; if unsure, treat the trench as unsafe.

Table 8.1 Soil types and the usual support method

Soil	How it behaves	Usual support	Typical spacing (follow the drawing)
Rock	Stands well; loose blocks may fall	Often none; scale off loose pieces, add mesh or boards where cracked	As the engineer directs
Firm (stiff clay, murram, compact earth)	Stands for a short time, then cracks and slabs fall	Open timbering with poling boards	Boards at 0.9–1.8 m centres; struts at up to 1.8 m along the trench; walings at about 1.0–1.2 m vertical spacing
Loose (sand, gravel, fill)	Will not stand; runs to a slope	Close (continuous) sheeting; runners in very loose ground	Boards edge to edge; struts at 1.2–1.8 m
Waterlogged or soaked	Flows in; floor may heave	Close sheeting or runners, sump and pump; steel sheet piles for deep work	As loose soil, often closer; engineer's design
Black cotton soil	Hard and cracked when dry, soft and slippery when wet	Treat as firm in the dry season, as loose when wet	Check after every rain

ON THE KENYAN SITE

Large areas around Nairobi, Machakos and Kisumu have black cotton soil. In the dry season it is as hard as concrete and seems to need no support. Then the long rains (March to May) or short rains (October to December) arrive, the clay swells and turns greasy, and the cracks behind the edge give way. Plan the timbering for the wettest day, not the driest.

SAFETY FIRST

Never enter an unsupported trench deeper than about 1.2 m, not even "just for a minute" to clear loose soil or fix a peg. Before anyone digs, ask for the location of buried cables, water mains and sewers, and use a cable detector where one is available. Never run a petrol or diesel pump or generator inside a trench: the exhaust fumes collect at the bottom.

8.2 Parts, Materials and Tools

8.2.1 The members of trench timbering

Every timbered trench is built from the same few members (Table 8.2). Remember: **boards stand up** against the wall, **walings run along** the trench, and **struts go across** it.

Table 8.2 Members of trench timbering

Member	Direction	Job	Typical size (follow the drawing)
Poling board	Vertical, flat against the wall, with gaps between boards	Holds firm soil in place	225 x 38 mm or 225 x 50 mm (9x2), 1.0–2.0 m long
Sheeting board	Vertical, edge to edge	Holds loose or wet soil; no gaps	150–225 mm wide, 38–50 mm thick
Waling	Horizontal, along the trench	Presses the boards against the wall and spreads the strut load	150 x 75 mm (6x3) or 225 x 75 mm
Strut	Horizontal, across the trench	Pushes the two sides apart	100 x 100 mm (4x4), eucalyptus poles 100–150 mm diameter, or adjustable steel trench props
Folding wedges	At one end of each strut	Tighten the strut; knock out for removal	Cut from hardwood or sound offcuts, about 300 mm long
Lip block (cleat)	Nailed on top of the strut end	Stops the strut dropping	Offcut about 150–200 mm long
Puncheon	Vertical, between two walings	Carries the lower waling; stops it sliding down	Same section as the strut, cut to fit
Runner	Vertical, driven ahead of the dig	Supports very loose or wet ground	Long boards or steel sheets

Kenyan sites use sawn cypress or pine for boards and walings, and eucalyptus (blue gum) poles for struts. Convert sizes when you read a drawing: 9x2 inches is 9 x 25.4 = 228.6 mm by 2 x 25.4 = 50.8 mm, called 225 x 50 mm; 14 ft is 14 x 0.3048 = 4.27 m. Timber need not be planed, but it must be sound: no large knots, splits, rot or insect damage.

8.2.2 Other materials and fixings

- Round wire nails, 75 mm and 100 mm, or double-headed (duplex) nails, which are easy to pull out later.
- Metal plates, hoop iron and binding wire to join or tie members.
- Adjustable steel trench props, which replace timber struts and wedges and are tightened with a screw collar.
- Treated timber where boards will stay in wet ground for a long time.

8.2.3 Tools and equipment

Tape, spirit level, plumb bob and string line; crosscut or circular saw; claw, club and sledge hammers; pincers and wrecking bar; drill; shovels; ladders; barriers and signs; and a pump where water is expected. See Chapter 4 for safe use.

8.2.4 Preparing the members

Cut and stack the members before the trench is dug, so that support can follow the digging closely.

1. Read the drawing: width, depth, length, soil and method. Make a cutting list (Chapter 7).
2. Cut poling boards to length. Allow about 150 mm above ground so the top acts as a toe board that stops tools and stones falling in.
3. Work out the strut length (see 8.4.3) and cut the struts square at both ends so they bear fully.
4. Cut folding wedges and lip blocks from offcuts.
5. Reject steel props with bent tubes, worn threads or missing pins. Stack everything well back from the edge.

> **GREEN TIP**
>
> Trench timber can be used again and again if it is handled with care. Use double-headed nails or no nails at all where wedges will hold the frame, so boards are not split during removal. Cut wedges and lip blocks from offcuts instead of new timber. Steel trench props and boxes last for hundreds of uses. Buy timber from KFS plantations or licensed yards. Never soak boards in old engine oil: it leaches into soil and groundwater. If treatment is needed, use a product approved for ground contact and follow the label.

8.3 Methods of Support

8.3.1 Open timbering (poling boards) for firm soil

Firm soil needs holding only at intervals. Poling boards stand against both walls with gaps between them, walings run along in front of them at two or more levels, and wedged struts go across. Lip blocks stop the struts dropping. Figure 8.2 shows the arrangement in section and in elevation.

Typical spacings are poling boards at 0.9–1.8 m centres along the trench, struts at not more than about 1.8 m apart, and walings about 1.0–1.2 m apart in height. The top waling sits about 300–500 mm below ground level. These are a safe typical range only; the drawing and engineer have the final say.

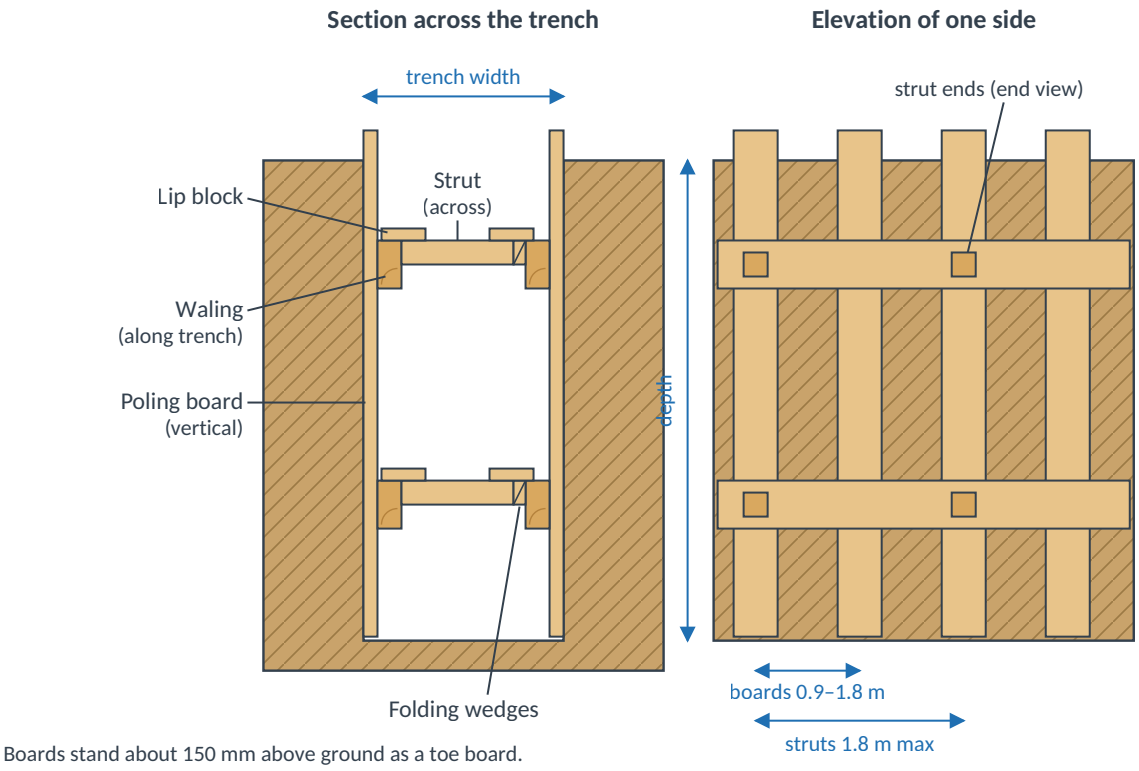


Figure 8.2 Open timbering in firm soil: poling boards stand against the wall, walings run along the trench and struts go across it.

8.3.2 Close sheeting for loose and wet soil

Loose soil runs through any gap, so boards are placed edge to edge as close sheeting (Figure 8.3). Walings and struts are as for open timbering but usually closer together. In a trench dug in lifts, lower walings hang from the upper ones on puncheons.

In waterlogged ground, dig a small sump at a low point and pump the water out. Keep the pump on firm ground away from the edge and discharge to a drain. If soil washes through a joint, pack it with sacking or a plank at once.

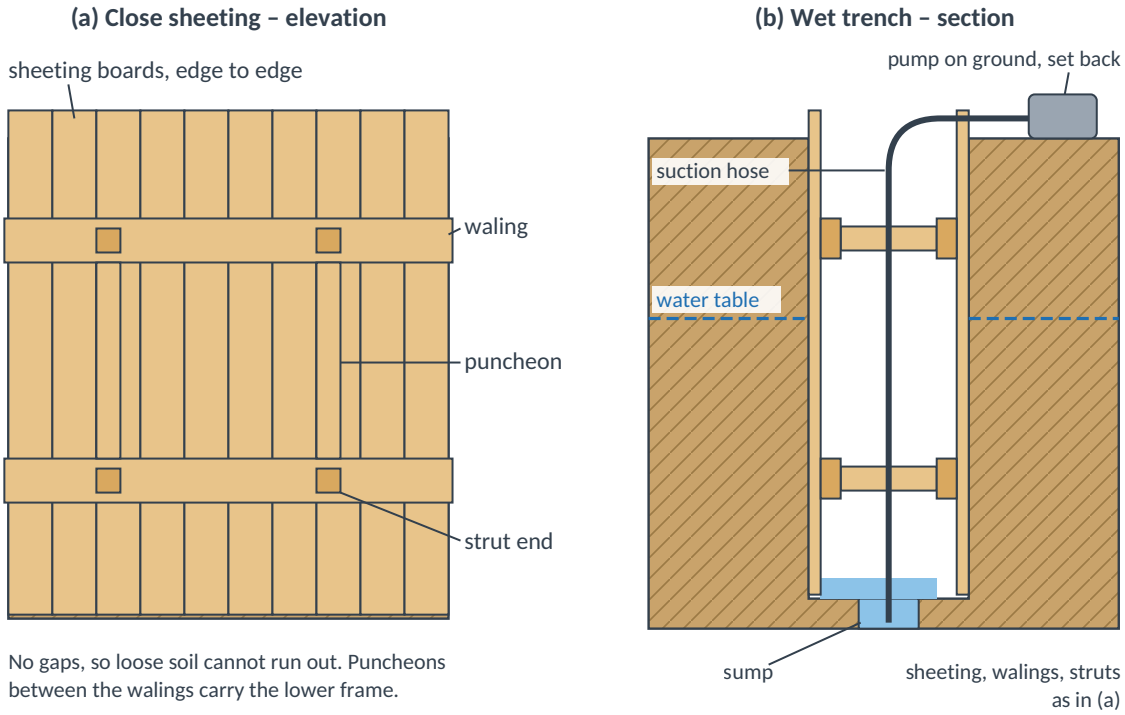


Figure 8.3 Close sheeting for loose ground (a) and a waterlogged trench with sump and pump (b).

8.3.3 Runners and sheet piles

In running ground, even a short unsupported depth collapses. Runners are long boards or steel sheets driven down ahead of the digging so the soil is never exposed; walings and struts are added as the depth increases. Interlocking steel sheet piles do the same for deep, wet work. They are designed by an engineer, but you may help fit walings and struts inside them.

8.3.4 Steel trench props and trench boxes

Adjustable steel trench props replace timber struts and wedges: set them roughly to length with the pin, then turn the threaded collar to tighten. Trench boxes are steel frames with solid side panels, lowered in by excavator; workers stay inside the box. Larger Kenyan contractors use both on sewer and water mains because they are faster and safer than timber.

8.4 Installing Trench Timbering

8.4.1 Work from the top down

Support must follow the digging closely. Nobody works below the lowest frame of support. The usual sequence is shown in Figure 8.4.

1. **Dig the first lift.** Set out with pegs and lines (Chapter 5) and dig to about 1.0–1.2 m, less in poor ground. Nobody enters.
2. **Fit the top frame.** Lower the boards from the top, flat against the wall. Hold the walings against them, fit struts square across, tighten the wedges and nail on lip blocks.
3. **Dig the next lift in short lengths.** Drive the boards down as digging proceeds, or place a second set below. Hang the lower walings on puncheons.

4. **Fit the lower struts and check.** Wedge the lower struts, check plumb, level and tightness, and place the ladder. A competent person inspects before anyone enters.

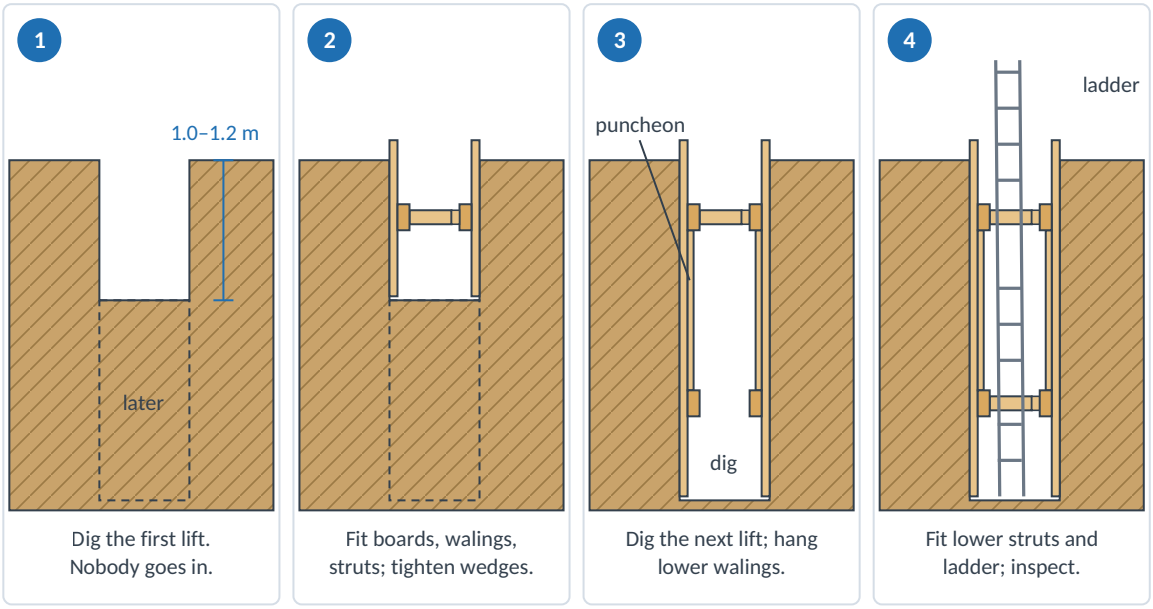


Figure 8.4 Installing open timbering from the top down, one lift at a time.

8.4.2 Securing and bracing to suit the soil

A loose strut does nothing until the soil has already moved. Follow these rules:

- Fit struts horizontal and square to the trench, centred on the walings. A strut on a slope can slip out.
- Drive the folding wedges from opposite sides until the frame is firm. Do not split the waling.
- Fix lip blocks on every strut end so that it cannot drop if the wedges loosen.
- In loose soil, use close sheeting and put the struts closer together. In wet soil, add pumping and check more often.
- At trench ends and corners, add end boards and extra struts or braces.
- Joint walings over a strut, never in the middle of a bay.
- Check boards for plumb and walings for level as you go.

8.4.3 Working out strut length

The strut fits between the faces of the two walings, less a gap for the folding wedges:

Strut length = trench width − 2 x board thickness − 2 x waling thickness − wedge allowance

Example: a trench 900 mm wide with 50 mm poling boards, 75 mm walings and a 25 mm wedge allowance needs struts of 900 − 100 − 150 − 25 = 625 mm. Measure the trench at each strut position and cut each strut to fit.

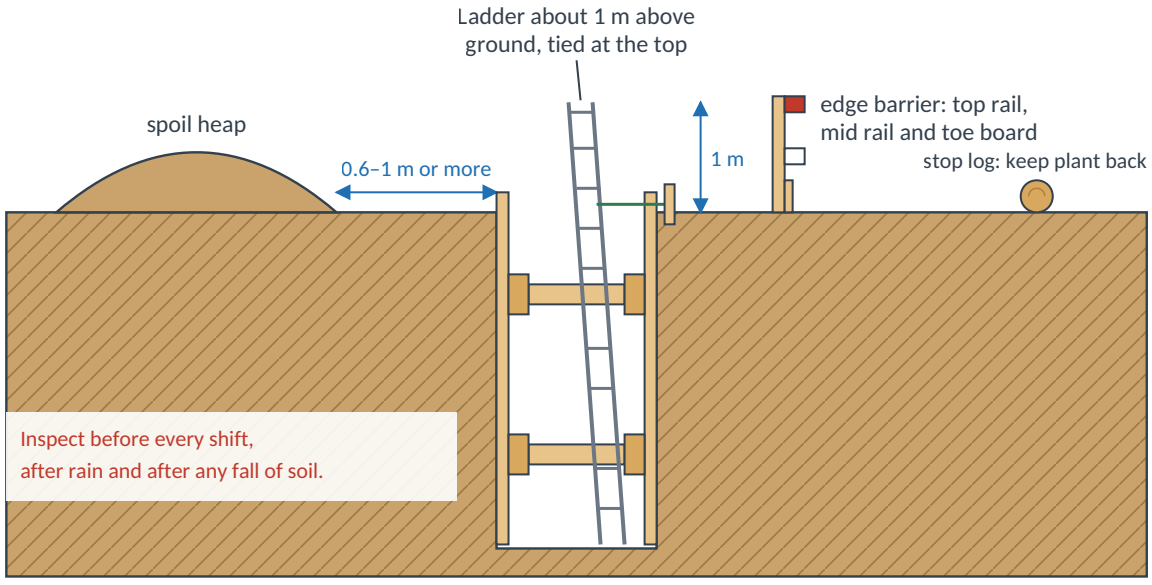
TRAINER'S TIP

Element 2 of Unit 1 carries 23 of the 100 marks, and most of them go to three things: fitting the boards, walings and struts as the drawing shows, securing and bracing for the soil type, and inspecting and maintaining the timbering. In the assessment, name each member as you fit it and explain why you chose open timbering or close sheeting.

8.5 Safe Access, Edge Protection and Spoil

The Kenya Building Code 2024 and the Occupational Safety and Health Act 2007 both expect excavations to have safe means of getting in and out, and protection at the edge. Figure 8.5 shows the main points.

- **Ladders.** Provide a sound ladder close to where people are working. It should stand on firm ground, extend about 1 m above the ground level, and be tied at the top. Never climb the struts: they are not designed for that.
- **Spoil set back.** Keep spoil heaps at least 0.6–1 m back from the edge, and further for deep trenches or loose ground. This keeps the surcharge off the sides and stops stones rolling in.
- **Barriers.** Put up a barrier with a top rail at about 1 m high and a toe board, or a strong fence where the public pass. Add warning signs and, at night, lights or reflectors.
- **Plant and vehicles.** Keep excavators, tippers and mixers back from the edge. Use stop logs or blocks so that a reversing lorry cannot reach the trench.
- **Crossings and materials.** Provide walkways with handrails, not loose planks. Lower materials in; never throw them.



Keep spoil, materials and vehicles back from the edge. Never stand at the edge of an unsupported trench.

Figure 8.5 Safe access and edge protection: ladder, spoil set-back, barrier and stop log.

8.6 Inspecting and Maintaining the Timbering

Soil moves, timber shrinks and wedges work loose. A competent person must inspect the trench and supports:

- before the start of every shift;
- after heavy rain or flooding;
- after any fall of soil, damage to a member, or blasting and heavy vibration nearby;
- whenever the support is changed or extended.

Record each inspection: date, time, inspector, findings and action. Use Table 8.3. If anything looks wrong, get everyone out first and fix it from the top.

Table 8.3 Daily inspection checklist for a timbered trench

Check	Warning sign	Action
Edges and ground behind	New cracks parallel to the trench; ground sinking	Clear everyone out; add struts or sheeting; move loads back
Boards and sheeting	Bulging, split or broken boards; soil running through gaps	Replace boards; close the gaps; change to close sheeting
Walings and joints	Waling bent or sagging; joint not over a strut	Add a strut or puncheon; replace the waling
Struts and wedges	Loose wedges; strut out of square; strut bowing	Re-tighten wedges; refit square; replace bowed strut
Water	Water on the floor; soft, wet faces	Pump out from outside; check sheeting; inspect more often
Access and edge	Ladder missing or loose; barrier down; spoil creeping to edge	Fix ladder and barrier; move spoil back

Timber shrinks as it dries, so tap the wedges each morning. Replace split, bent or rotten members. Strengthen critical areas: trench ends, pipe crossings, access points and places near traffic.

COMMON MISTAKES

- Digging the whole depth first and then trying to fit support from inside the trench.
- Fitting struts on a slope or off-centre on the walings, so they slip out.
- Using open timbering in sand or fill, where the soil pours through the gaps.
- Tipping spoil right at the edge "to save time", adding surcharge to the sides.
- Climbing up and down on the struts instead of using a ladder.
- Skipping the morning check after a night of rain.

8.7 Removing Trench Timbering

When the pipes or foundations are complete and approved, the trench is backfilled and the timbering is removed. The rule is the opposite of installation: **remove from the bottom up, as the backfill rises**. Backfill and compact up to just below the lowest struts, ease the wedges, remove that frame, then repeat. Never take out a strut while anyone is in the trench below it. Chapter 11 covers dismantling in detail.

8.8 Housekeeping and Green Practice

- Clean, check and store tools after use.
- De-nail recovered timber at once; sort it into reusable lengths, wedge stock and waste; stack it flat on bearers under cover.
- Collect bent nails, wire and hoop iron for scrap recycling; give sawdust and small offcuts for briquettes or animal bedding.
- Dispose of waste through licensed collectors as NEMA and EMCA 1999 (revised 2015) require.

8.9 Worked Example: Timbering a 10 m Trench

A foundation trench is **10 m long, 0.9 m wide and 1.8 m deep** in firm murram. The drawing shows open timbering with poling boards 225 x 50 mm (9x2) at about 0.83 m centres on each side, walings 150 x 75 mm (6x3) at two levels, and struts 100 x 100 mm (4x4) at not more than 1.8 m centres. Work out the timber to buy and the approximate cost (Figure 8.6).

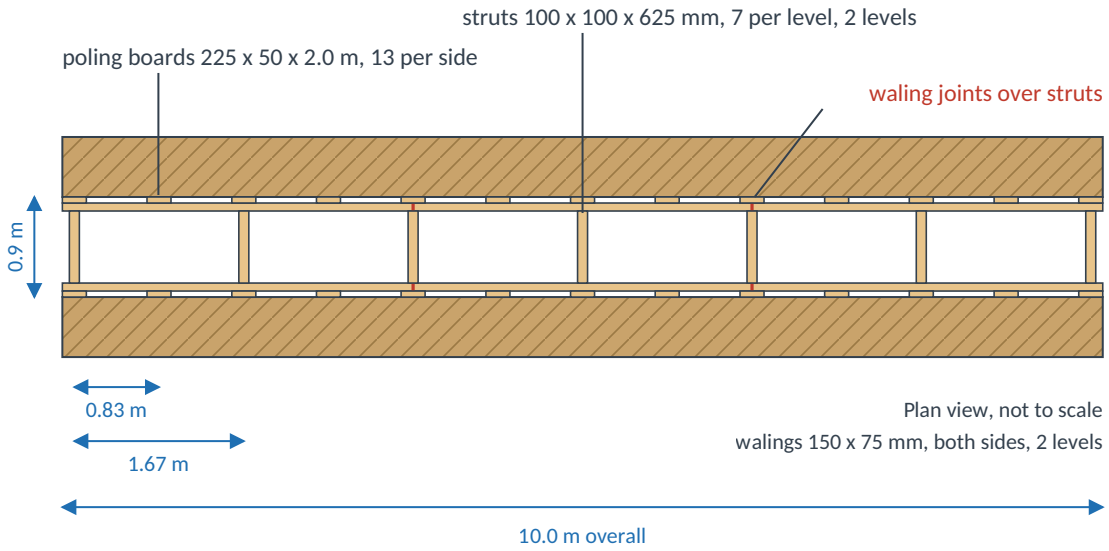


Figure 8.6 Plan of the worked-example trench: board and strut spacing, with waling joints placed over struts.

Step 1 – Poling boards. Spacing 0.83 m along 10 m gives 10 ÷ 0.83 = 12 spaces, so 12 + 1 = 13 boards per side, and 13 x 2 = 26 boards. Each board is 1.8 m deep plus about 0.2 m above ground = 2.0 m. One 14 ft length is 14 x 0.3048 = 4.27 m, which gives two boards of 2.0 m with a 0.27 m offcut. Boards to buy: 26 ÷ 2 = **13 pieces of 9x2 x 14 ft** = 182 ft (182 x 0.3048 = 55.5 m).

Step 2 – Struts. Struts must be at most 1.8 m apart: 10 ÷ 1.8 = 5.6, so round up to 6 spaces of 10 ÷ 6 = 1.67 m. That gives 6 + 1 = 7 positions, at every second poling board. With 2 levels, struts = 7 x 2 = 14. Strut length = 900 − (2 x 50) − (2 x 75) − 25 = 625 mm. A 10 ft length (3.05 m) gives 4 struts (4 x 0.625 = 2.5 m) with 0.55 m over. Struts to buy: 14 ÷ 4 = 3.5, so **4 pieces of 4x4 x 10 ft** = 40 ft (12.2 m), with two spare struts.

Step 3 – Walings. Each run of waling is 10 m long. There are 2 sides x 2 levels = 4 runs = 40 m. Joints must fall over a strut, so cut each run into three lengths of 3.33 m with joints at the 3rd and 5th strut positions (3.33 m and 6.67 m). A 12 ft length is 12 x 0.3048 = 3.66 m, enough for one 3.33 m piece. Walings to buy: 4 runs x 3 = **12 pieces of 6x3 x 12 ft** = 144 ft (43.9 m). The twelve offcuts of about 0.33 m make the folding wedges and lip blocks.

Step 4 – Nails. Lip blocks and puncheons need about 2 kg of 100 mm wire nails.

Step 5 – Cost (approximate, 2026). Poling boards 9x2 at KSh 140 per ft: 182 x 140 = 25,480. Walings 6x3 (not on the usual price list; about one and a half times the 6x2 price of KSh 85, so about KSh 130 per ft): 144 x 130 = 18,720. Struts 4x4 at KSh 110 per ft: 40 x 110 = 4,400. Wire nails 2 kg x KSh 200 = 400.

Total: 25,480 + 18,720 + 4,400 + 400 = **KSh 49,000**. The total timber is 182 + 144 + 40 = 366 ft, or about 111.6 m. If the same timber is recovered with care and used on eight trenches, the timber cost per trench (25,480 + 18,720 + 4,400 = KSh 48,600) falls to about 48,600 ÷ 8 = KSh 6,075, say KSh 6,100. Prices vary, so always get a current quotation.

Practical task 8.1: Install open timbering in a training trench

Support a training trench 3.0 m long, 0.75 m wide and 1.5 m deep in firm ground, dug in two lifts, with open timbering at two levels: four boards per side and struts at three positions.

Tools and equipment

- Measuring tape, spirit level, plumb bob, string line and pegs
- Crosscut saw, claw hammer, club hammer
- Pincers, wrecking bar
- Aluminium or timber ladder
- Barrier tape or rails, warning sign
- PPE: helmet, safety boots, gloves, reflective vest, goggles

Materials

- 8 poling boards 225 x 50 x 1.65 m
- 4 walings 150 x 75 x 3.0 m
- 6 struts 100 x 100 mm (or 6 adjustable steel trench props)
- 6 pairs of folding wedges and 12 lip blocks from offcuts
- 75 mm and 100 mm wire nails or double-headed nails

Steps

1. Study the sketch and the soil, and confirm no services are buried there. Put on PPE, set up the barrier and keep 1 m clear on each side.
2. Prepare the members: cut boards to length, measure the trench width and calculate the strut length (750 − 100 − 150 − 25 = 475 mm). Cut wedges and lip blocks from offcuts.
3. After the first lift (about 0.75 m) is dug, lower the poling boards into position from the top at about 1.0 m centres, flat against the walls, projecting about 150 mm above ground.
4. Place the top walings against the boards. Fit the top struts square across the trench at 1.5 m centres, centred on the walings. Drive the folding wedges until firm. Nail on the lip blocks.

5. Check boards for plumb and walings for level; adjust and re-wedge.
6. As the second lift is dug, drive the boards down, hang the lower walings on puncheons and fit the lower struts.
7. Tie the ladder about 1 m above ground. The trainer inspects before anyone enters; record it using Table 8.3.
8. Later, remove the timbering bottom up during backfill; de-nail, sort, stack and clean up.

Safety

- Do not enter the trench until the frame above you is fitted and checked.
- Keep spoil, timber and tools back from the edge.
- Stop work and get out if you see cracks, bulging boards or running soil.

Chapter summary

- Trenches collapse because the soil in front of the sides has been removed; water, vibration and surcharge make it worse.
- Firm soil is held with open timbering; loose and wet soil need close sheeting, and wet ground also needs pumping.
- Poling boards stand vertically against the wall, walings run along the trench and struts go across it, tightened with folding wedges and held by lip blocks.
- Support is installed from the top down, lift by lift, and nobody works below the lowest frame.
- Safe access means a tied ladder about 1 m above ground, spoil set back at least 0.6–1 m, barriers and plant kept back.
- Inspect before every shift and after rain or any fall of soil, record it, and re-tighten or strengthen as needed.
- Timbering comes out bottom up as backfill rises; careful removal allows reuse.

Check your competence

- [ ] I can choose and prepare the right timber, fixings, tools and equipment for trench support from the drawing and instructions.
- [ ] I can name poling boards, sheeting, walings, struts, wedges, lip blocks and puncheons and fit each one the right way.
- [ ] I can install boards, walings and struts in the positions and spacings shown on the drawing.
- [ ] I can judge the soil and secure and brace the support so the trench cannot collapse.
- [ ] I can calculate strut length and the quantity of timber for a trench.
- [ ] I can set up safe access, edge barriers and spoil set-back as the building code requires.
- [ ] I can inspect timbering, record the result and strengthen weak or critical areas during the excavation.
- [ ] I can clean and store tools, sort and stack recovered timber and dispose of waste responsibly.

Practice questions

1. Name four soil types found on Kenyan sites and describe how each behaves when a trench is dug in it.
2. Explain the difference between a poling board, a waling and a strut. In which direction does each one run?
3. When would you use close sheeting instead of open timbering? Give two reasons.
4. What is surcharge? Give three examples you might see on a building site.
5. Calculate the strut length for a trench 1,000 mm wide, using sheeting 38 mm thick, walings 75 mm thick and a wedge allowance of 25 mm.
6. A trench is 8 m long. Struts must be no more than 1.8 m apart, at two levels. How many struts are needed, and what is the actual spacing?
7. Convert a 12 ft length of 6x3 timber to metric (length in metres, section in mm).
8. Oral: describe four rules for safe access and edge protection around a trench.
9. When must trench timbering be inspected, and what should be written in the record?
10. Practical: in a training trench, fit one frame of open timbering (two poling boards each side, walings and two struts with wedges and lip blocks) and explain each step to your assessor.

Enjoyed the sample?

The full **Carpentry and Joinery Level 3** study guide has 17 chapters across all three core units: Temporary Works (trench timbering, formwork, shuttering, striking), Door and Window Frames, and Cabinetry Works. It also has 100+ labelled drawings, worked quantities and costings, practical task cards, practice questions with answers and three mock practical assessments.

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