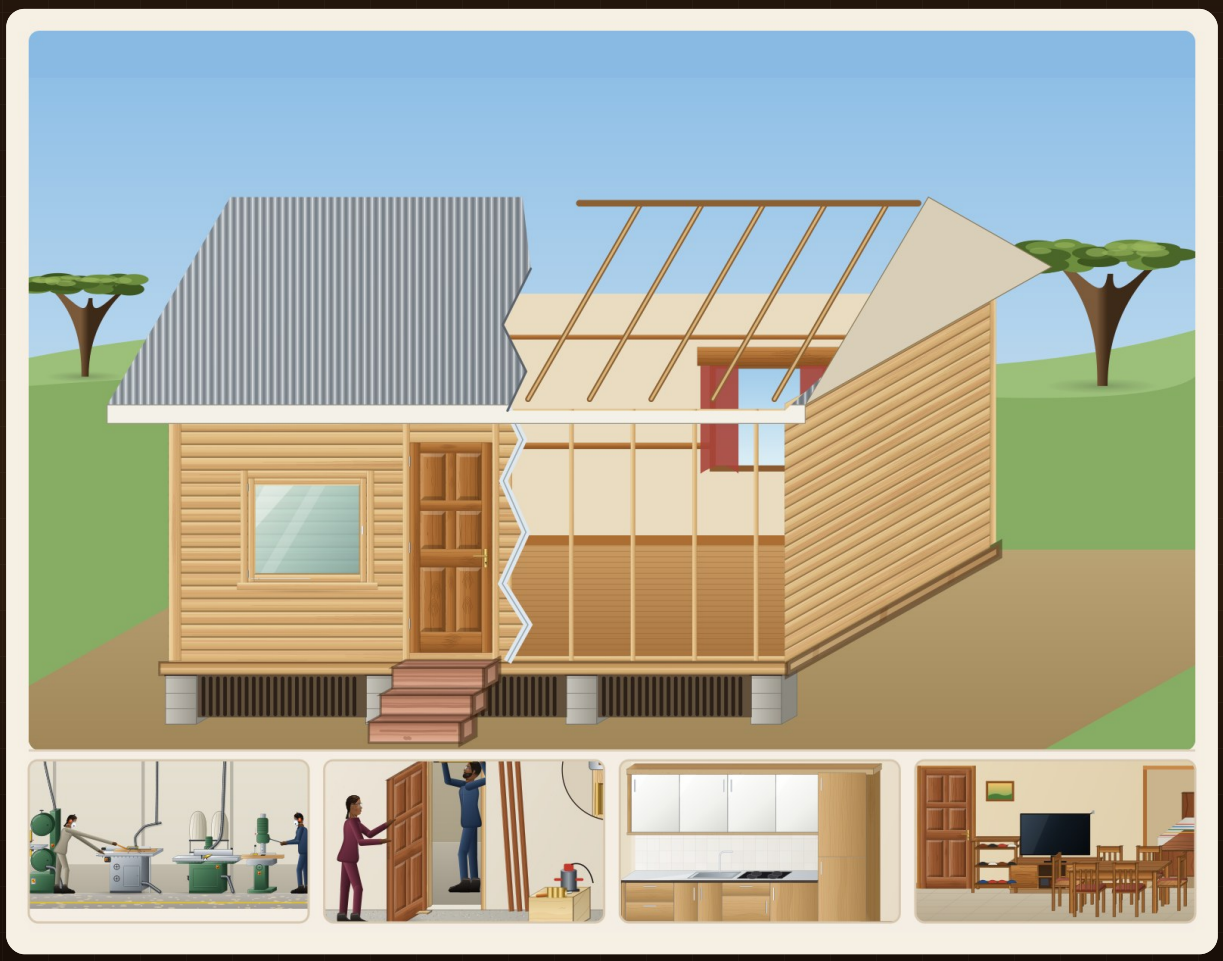
KNQF LEVEL 4 · TVET CDACC CYCLE 3

Carpentry and Joinery

Level 4

A Practical Study Guide for Kenyan Trainees

Rough carpentry · Doors & windows · Furniture · Floors & frames · Cabinets



Realistic pictures **Step-by-step tasks** **Mock assessments**

For trainees, RPL candidates, trainers and carpentry fundis

Alphonce Kimutai Kirui

Aligned to the TVET CDACC Competency-Based Modular Curriculum, Carpentry and Joinery KNQF Level 4

Carpentry and Joinery Level 4

A Practical Study Guide for Kenyan Trainees

Rough Carpentry · Doors and Windows · Timber Furniture Items · Timber Floors and Framed Structures · Cabinets Construction · Industrial Training
Kenya National Qualifications Framework (KNQF) Level 4

Alphonce Kimutai Kirui

Carpentry and Joinery Level 4: A Practical Study Guide for Kenyan Trainees
First edition, November 2026

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Published by the author. Website: alphoncekirui.com

About the curriculum

This book follows the topics and units of the TVET CDACC Competency-Based Modular Curriculum and Occupational Standard for Carpentry and Joinery, KNQF Level 4 (Cycle 3, greened edition), and the assessment documents for Carpenter and Joiner Level 4. It covers the five Level 4 units (Module II): Rough Carpentry (CON/CU/CAJ/CR/01/4/MB, 80 hours), Doors and Windows (CON/CU/CAJ/CR/02/4/MB, 120 hours), Timber Furniture Items (CON/CU/CAJ/CR/03/4/MB, 100 hours), Timber Floors and Framed Structures (CON/CU/CAJ/CR/04/4/MB, 100 hours) and Cabinets Construction (CON/CU/CAJ/CR/05/4/MB, 80 hours), together with the industrial training. The Level 3 units of the qualification (Module I: Temporary Works, Door and Window Frames and Cabinetry Works) are covered in the companion book, *Carpentry and Joinery Level 3: A Practical Study Guide for Kenyan Trainees*, by the same author. Unit titles and codes are used for reference only.

This is an independent study guide. It is not published or endorsed by TVET CDACC, TVETA or the Ministry of Education. Always follow the current official curriculum and your trainer's guidance.

Safety and accuracy notice

Carpentry and joinery work can injure and kill. Table saws, planers, spindle and router cutters take fingers in a moment and throw work back at the operator; scaffolds, towers and ladders collapse or are fallen from; shores and props that are removed in the wrong order can bring down a wall; wood dust causes cancer and asthma; solvent finishes and contact adhesives catch fire and harm the lungs; and doors, sheets and frames are heavy and awkward to lift. The methods in this book are for training under the supervision of a qualified trainer, always with the guards in place and the correct personal protective equipment. Use only machines you are trained and authorised to use, never wear gloves near a rotating blade, never use an uninspected scaffold, and leave the design of shores, scaffolds for unusual loads, floor joists and structural frames to the engineer or designer named on the drawing. Values given as "typical" or "example" (sizes, gaps, moisture contents, joint proportions, spacings, quantities and prices) are general guidance only: always follow the drawing, the job specification, the engineer or supervisor, and the maker's instructions. Follow the current Kenyan laws and rules, including the National Building Code 2024, the Occupational Safety and Health Act 2007 and its rules, the Environmental Management and Co-ordination Act, the Sustainable Waste Management Act 2022, the Forest Conservation and Management Act 2016 and the Pest Control Products Act. Prices are approximate (2026) and vary by town.

Names of people, businesses, schools and sites used in examples are made up for teaching. Tools, machines, boards, finishes and ironmongery are described by type, not by brand.

Illustrations and photographs

The illustrations in this book were drawn for it. They are realistic teaching illustrations and are not to scale unless dimensions are given. Charts marked "typical" or "example" show typical shapes and values, not measured data. A few diagram details are adapted, with additions, from the author's Level 3 guide and are marked in their captions. Photographs come from Wikimedia Commons under free licences (public domain, CC0, CC BY or CC BY-SA); some have been resized or cropped. Each photograph is credited under the picture, and the full list of credits is at the back of the book.

How this book was made

Automated tools, including AI writing and drawing assistants, were used under the author's direction to help draft the text, draw the illustrations and charts, and check calculations, cross-references and layout. The content was checked against the curriculum documents and against published sources such as the National Building Code 2024, Kenya Standards for timber and boards, makers' data and Kenyan law, and the author is responsible for it. If you find a mistake, please report it through alphoncekirui.com so that it can be corrected in the next edition.

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Preface

Walk through any Kenyan town and you will see the work of carpenters and joiners: an iron-sheet hoarding with a gate along a new building site, eucalyptus-pole scaffolds against a block of flats, panel doors and casement windows going into a new bungalow, a cypress dining set on a lorry heading for a family's first home, a timber-framed cottage at a lodge by the lake, and rows of kitchen units in an apartment block. The Affordable Housing Programme, schools, hospitals, hotels and lodges all need people who can read a drawing, work out what to buy, set out and machine the parts safely, put them together square and true, finish them well and fix them on site. That is the Level 4 carpenter and joiner.

This guide covers the new units of the Carpentry and Joinery KNQF Level 4 course (Module II): Rough Carpentry, Doors and Windows, Timber Furniture Items, Timber Floors and Framed Structures and Cabinets Construction, together with the industrial training and the assessments that lead to your certificates. The Level 3 units of the qualification (Module I: Temporary Works, Door and Window Frames and Cabinetry Works) are not repeated here. They are covered in the companion book, *Carpentry and Joinery Level 3: A Practical Study Guide for Kenyan Trainees*, which this book calls "the Level 3 guide". Where a Level 4 job uses a Level 3 skill, such as choosing timber, sharpening a chisel, making a frame or fixing a kitchen unit, this book gives a short reminder and points you to the right chapter of the Level 3 guide.

The book is written for trainees in vocational training centres and technical colleges, for candidates seeking recognition of prior learning, for trainers, and for working carpenters, joiners and fundis in contractors' firms, joinery workshops, furniture makers, kitchen fitters and maintenance teams who want their skills recognised. Everything is explained in plain English, with realistic drawings, full-size rods and cutting lists, worked calculations using Kenyan timber sizes, prices and conditions, practical tasks with record sheets, and checklists matched to the way you will be assessed.

Above all, work safely. Woodworking machines, scaffolds and shores injure carpenters in Kenya every year, and wood dust and solvents harm health slowly. Learn the safety rules in Chapter 2 before you switch on a machine, climb a scaffold or strike a shore, and keep to them on every job. And use timber well: buy it legally, plan your cuts, reuse what you take down and turn offcuts into products. A Level 4 carpenter who wastes less earns more.

Alphonce Kimutai Kirui
Bomet, November 2026

How to use this book

This book follows the Level 4 part of the Carpentry and Joinery course from start to finish. It covers the five Level 4 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. Topics that all five units share are taught once in Part 1: safety and green practice (Chapter 2), working drawings, measurement and timber science (Chapter 3), and materials, cutting lists and costing (Chapter 4 — the costing method the whole book uses). Within the units, woodworking machines are taught in depth in Chapter 7, joints in Chapter 8 and finishing in Chapter 9; later chapters add only their own joints, finishes and machine set-ups. Level 3 topics are summarised and referred to the Level 3 guide.

The course at a glance

Part	What it covers	Training time
1. Getting started, safety, drawings and costing	The Level 4 carpenter and the course, assessment, machine and site safety, green practice, working drawings, rods, measurement and conversions, moisture content and movement, materials, cutting lists, cutting patterns and quotations	Used throughout (about 45 hours of the five units)
2. Rough carpentry	Unit 1 (CON/CU/CAJ/CR/01/4/MB): hoarding, raking, flying and dead shores, pole and tube scaffolds and towers; planning, setting out, erecting, inspecting, dismantling and reusing	80 hours
3. Doors and windows	Unit 2 (CON/CU/CAJ/CR/02/4/MB): types and parts, rods and cutting lists, marking out, woodworking machines, joints, gluing up, finishing, hanging doors, fitting windows and ironmongery, architraves	120 hours
4. Timber furniture items	Unit 3 (CON/CU/CAJ/CR/03/4/MB): furniture drawings and ergonomics, tables, chairs and beds, furniture joints and knock-down fittings, shaping, assembling, testing strength and stability, finishing and delivery	100 hours
5. Timber floors and framed structures	Unit 4 (CON/CU/CAJ/CR/04/4/MB): suspended floors, joists and strutting, boarded, parquet and floating floors, sanding and finishing; platform and balloon frames, cladding, linings and second fixings	100 hours
6. Cabinets construction	Unit 5 (CON/CU/CAJ/CR/05/4/MB): cabinet drawings, panel lists and cutting patterns, cutting out, edging and drilling members, preparing backgrounds, fixing, cornice and skirting, laminating and finishing	80 hours
7. Industrial training and assessment	The industrial training, the mentoring tool and portfolio, running joinery jobs, a small carpentry business, and mock assessments for all five units	240 hours in the curriculum table (confirm with your institution)

The new Level 4 work is 80 + 120 + 100 + 100 + 80 = 480 hours of units (48 credits) plus 240 hours of industrial training as the curriculum's unit table gives: 720 hours. The full Level 4 qualification also includes the three Level 3 units (Module I, 350 hours), covered in the Level 3 guide: 1,070 hours (107 credits) in all. Chapter 1 explains the industrial-training hours in more detail.

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 realistic labelled illustrations, working drawings, rods, sections, cutting patterns, charts, drawn forms and photographs.
- **Worked examples:** cutting lists, timber and board quantities, cutting-pattern yields, raker lengths, scaffold loads, joint sizes, finish quantities, floor and frame take-offs and full quotations worked through with real numbers and Kenyan prices.

- **Practical tasks:** real workshop and site jobs with the tools, materials, steps, safety points and a "Record your results" table to fill in. 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, with full working for calculations, 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, energy and materials, choose legal timber and low-VOC finishes, reuse what you take down and turn offcuts into products.

TRAINER'S TIP

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

COMMON MISTAKES

Errors trainees often make, and how to avoid them.

ON SITE IN KENYA

How the topic looks on real Kenyan jobs: building sites and housing projects, joinery workshops and furniture makers, schools, lodges and apartment blocks.

WORKED EXAMPLE

A calculation worked step by step with real numbers.

About the pictures and diagrams

This book uses realistic illustrations of real workshops, machines, sites and finished work, working drawings and full-size rods, sections, cutting patterns, charts, drawn forms and photographs. Labels and thin leader lines point to the parts that matter. On drawings, sawn timber is shown pale tan with darker end grain, planed timber lighter, boards with their plies or core visible, and metal in grey; dimensions are in millimetres unless marked. The five units keep the same colours throughout: **rough carpentry orange**, **doors and windows blue**, **furniture purple**, **floors and frames green** and **cabinets brown**. Red marks a danger, fault, mistake or cutting line; green marks the correct way or a green choice. Values marked "Example — follow the drawing and the maker's instructions" are typical, not rules. Some photographs show real workshops and sites where people are not following every safety rule; the captions point this out. Always wear the PPE shown in Chapter 2.

PART 1

Getting Started, Safety, Drawings and Costing

What a Level 4 carpenter and joiner does beyond Level 3, how the five Level 4 units and the industrial training are trained and assessed, and how this book links to the Level 3 guide. Then what every unit shares: machine, site and scaffold safety, dust, noise and finishes, green practice and turning offcuts into products; reading and checking working drawings, rods, measurement and conversions, moisture content and timber movement; and materials, cutting lists, cutting patterns and the costing method the whole book uses.

Chapter 1: Moving Up to Level 4: The Carpenter and Joiner Who Makes, Erects and Finishes
Chapter 2: Safety, Health and Green Practice on Level 4 Jobs
Chapter 3: Working Drawings, Measurement and Timber Science
Chapter 4: Materials, Cutting Lists and Costing for Joinery

CHAPTER 1

Moving Up to Level 4: The Carpenter and Joiner Who Makes, Erects and Finishes

WHAT YOU WILL LEARN

- Describe what a Level 4 carpenter and joiner does beyond Level 3.
- Explain how the course is built: units, codes, hours, credits and industrial training.
- Explain in outline how you are assessed and where the marks are.
- Describe the Kenyan carpentry and joinery scene and the rules you work under.
- Plan a career path and work professionally with clients and other professionals.
- Find your way around this book and your Level 4 workshop.

Course overview · Units CON/CU/CAJ/CR/01/4/MB, 02/4/MB, 03/4/MB, 04/4/MB, 05/4/MB and industrial training

At Level 3 you fixed door and window frames, built formwork and trench supports, and assembled and installed kitchen units. Someone else usually made the doors, the furniture and the cabinet parts. At Level 4 you make them yourself, in the workshop and on site. You also put up the hoardings, shores and scaffolds that keep a building site safe, and you build timber floors and timber-framed walls. This chapter shows you the road ahead.

Key words

Joinery
Making doors, windows, furniture and fitted units, mostly in a workshop, with close-fitting joints.

Rough carpentry
Temporary or structural timber work on site, such as hoarding, shoring and scaffolding, where strength matters more than finish.

Hoarding
A solid fence round a building site, usually of iron sheets (mabati) on timber posts and rails.

Shoring
Temporary timber supports that hold up a wall or structure while work goes on beside or below it.

Unit of competency
A block of the course with its own assessment and certificate.

Element
A main task inside a unit, such as "fit door and window joints".

PC weighting
The marks given to each performance criterion (PC) in formative assessment.

Greened curriculum
A curriculum that builds legal timber, material saving, safe finishes and waste control into every task.

Industrial training
Supervised work in a real workplace, often called attachment.

Portfolio of evidence
Your file of records, drawings, cutting lists, photos and reports that proves what you can do.

1.1 What a Level 4 Carpenter and Joiner Does

A Level 3 carpenter and joiner works from drawings and parts that someone else prepared. A Level 4 carpenter and joiner takes on the making and the bigger site work:

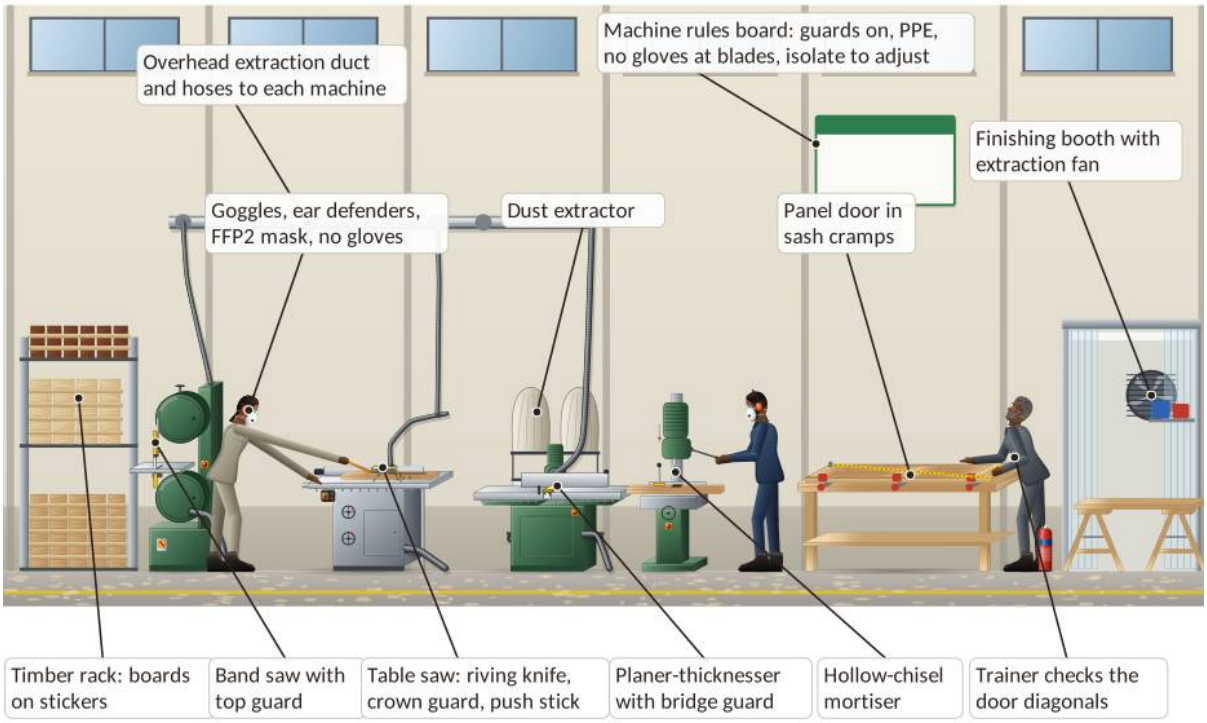
- **sets out, erects and dismantles rough carpentry**: site hoardings, raking and other shores, and pole or tube scaffolds;
- **makes doors and windows** from the rod (a full-size setting-out drawing), cuts and fits the joints, finishes them and hangs them;
- **makes furniture** such as dining tables, chairs, beds, TV stands and shoe racks;
- **builds timber floors and timber-framed structures**, such as a lodge cottage or a prefab classroom, and clads and finishes them;
- **cuts out, edges and drills cabinet members** and prepares the walls they fix to;
- **runs woodworking machines safely**, after training and under supervision;
- **guides Level 3 juniors** and speaks for the joinery work with clients, contractors and inspectors.

Table 1.1 shows how the same kind of job grows at Level 4. Figure 1.1 shows a workshop set up for this work, and Figure 1.2 shows how the five units fit on one site and one timber building.

Table 1.1 From Level 3 to Level 4: the same job, more responsibility

Job	Level 3 carpenter and joiner	Level 4 carpenter and joiner
Temporary works	Builds formwork and trench supports	Sets out and erects hoardings, shores and scaffolds, then dismantles them safely
Doors and windows	Fixes bought frames and hangs a door	Makes the leaves and sashes from a rod, finishes them, hangs them and fits architraves
Furniture	Repairs and assembles simple items	Makes tables, chairs and beds with strong joints and a good finish
Floors and frames	Fixes battens and simple framing	Builds suspended floors and wall frames to level and plumb, and clads them
Cabinets	Assembles and installs kitchen units	Cuts out, edges and drills the members, prepares the background, finishes the units
Paperwork	Fills a job card and a simple cutting list	Reads full working drawings, writes cutting lists, sheet layouts and quotations

A Level 4 joinery workshop: machine shop, assembly benches and finishing booth



Example layout — every workshop differs. Machines are generic; the guards shown must always be in place.

Figure 1.1 A Level 4 joinery workshop at a county VTC: the machine shop with extraction, the assembly bench where the trainer checks a door for square, and the finishing booth. Every machine has its guard in place and every trainee wears the PPE the task needs.

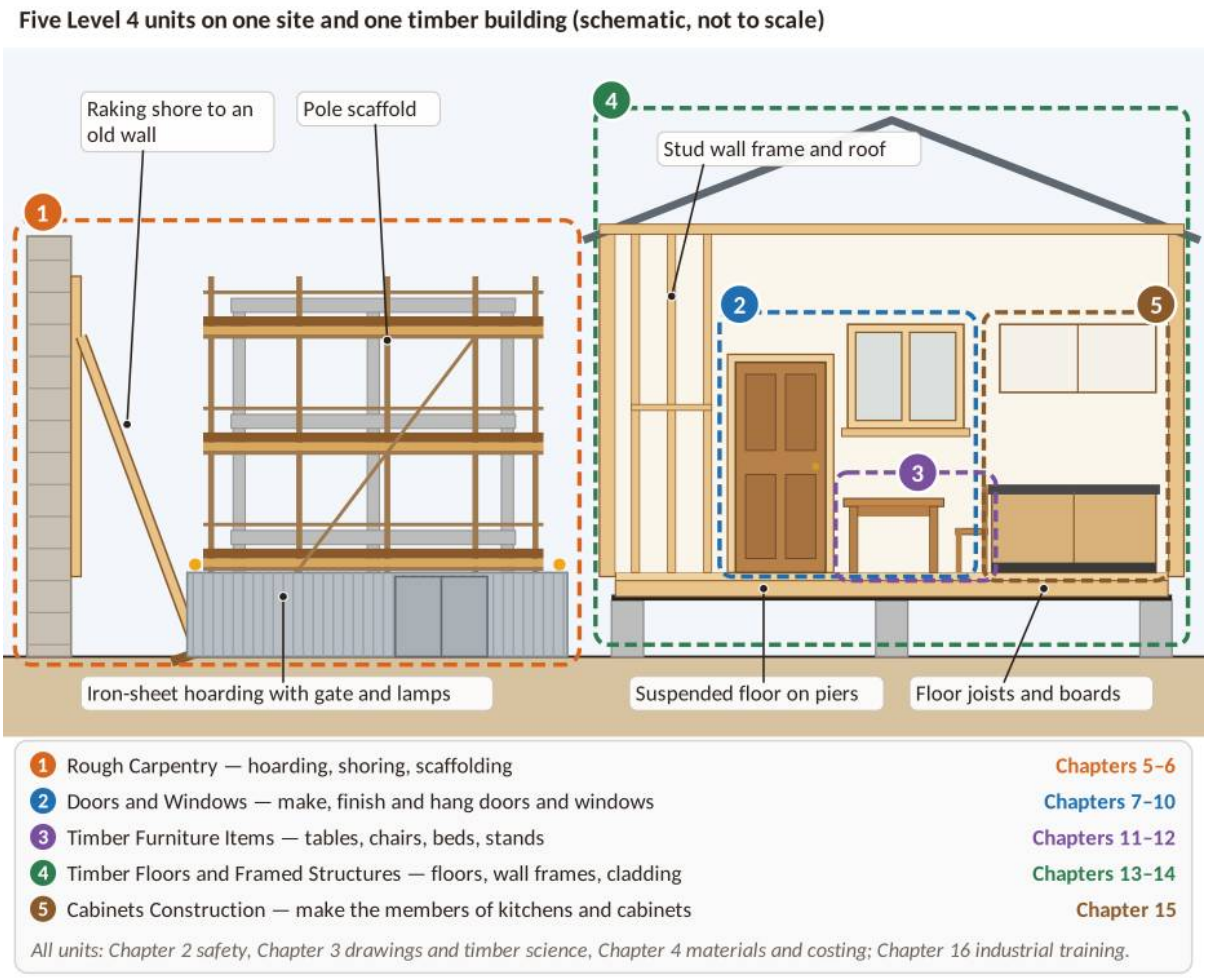


Figure 1.2 The five Level 4 units on one site and one timber building, colour-coded, with the chapters that teach each unit.

1.2 Where This Book Fits in the Course

The TVET CDACC curriculum for Carpentry and Joinery Level 4 (Cycle 3, greened edition) has two modules. **Module I** holds the three Level 3 units: Temporary Works, Door and Window Frames, and Cabinetry Works. **Module II** holds the five new Level 4 units in Table 1.2. Industrial training completes the course.

This book covers **only Module II and the industrial training**. Module I is taught in the companion book, *Carpentry and Joinery Level 3: A Practical Study Guide for Kenyan Trainees*, called "the Level 3 guide" from now on. If you enter from KCSE without Level 3, study the Level 3 guide alongside this one, because this book assumes its skills.

Table 1.2 The Level 4 units and where this book teaches them

Unit	Code	Hours	Credits	Chapters
Rough Carpentry	CON/CU/CAJ/CR/01/4/MB	80	8	5–6
Doors and Windows	CON/CU/CAJ/CR/02/4/MB	120	12	7–10
Timber Furniture Items	CON/CU/CAJ/CR/03/4/MB	100	10	11–12
Timber Floors and Framed Structures	CON/CU/CAJ/CR/04/4/MB	100	10	13–14
Cabinets Construction	CON/CU/CAJ/CR/05/4/MB	80	8	15
Industrial training	—	240	24	16
New Level 4 work		**720**	**72**	

Chapters 2, 3 and 4 cover what all five units share: safety and green practice, working drawings and timber science, and materials, cutting lists and costing. The occupational standard prints the same units with OS instead of CU, and the PC weighting tool you may be given uses the earlier …/MA version codes; they refer to the same units.

The whole course is 350 + 480 + 240 = 1,070 hours (107 credits); one credit is ten hours (Figure 1.3). This book uses the 240 hours of industrial training in the curriculum's unit table; the course documents do not all agree on this figure, so your institution confirms the period (Chapter 16, Table 16.2).

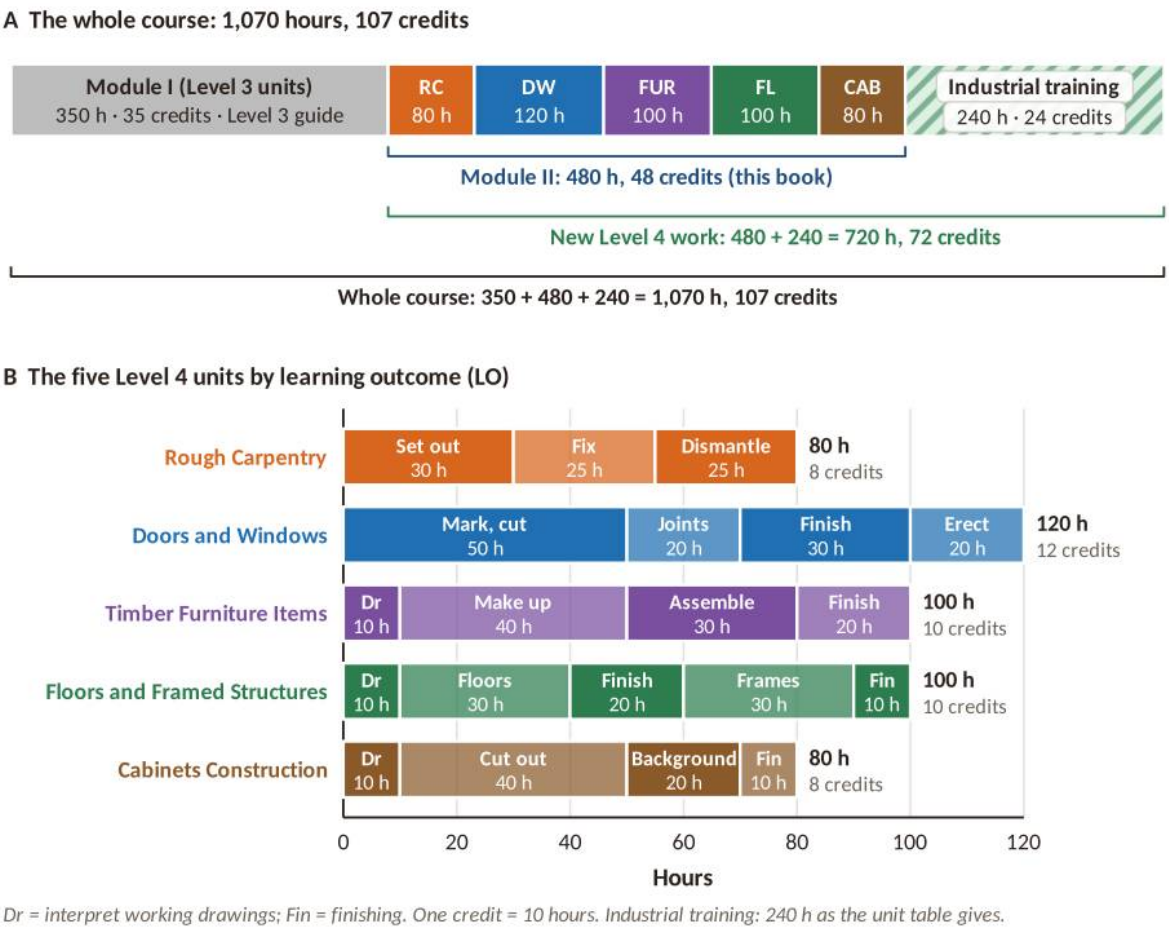


Figure 1.3 The course map. A: the whole course; this book covers Module II and the industrial training. B: the five Level 4 units split into learning outcomes. One credit is ten hours.

1.2.1 Entry, trainers and credit for Level 3

You can enter with a KCSE mean grade of D (plain) or an equivalent. If you hold a Carpentry and Joinery Level 3 certificate, ask your institution whether it admits you on that and about credit for Module I. Your trainer holds a higher qualification than Level 4 in carpentry and joinery or a related trade and is licensed by TVETA. Industrial training is spent in the construction sector, normally after all the units for the full qualification. A workplace mentor assesses you with the mentoring tool; Chapter 16 explains it.

WORKED EXAMPLE 1.1: HOURS TO WEEKS

Your VTC trains for 40 hours a week. How long are the Level 4 units, the industrial training, all the new Level 4 work and the whole course?

Weeks = hours ÷ hours per week

Level 4 units: 480 h ÷ 40 h/week = **12 weeks**

Industrial training: 240 h ÷ 40 h/week = **6 weeks** (30 working days of 8 hours)

New Level 4 work: 720 h ÷ 40 h/week = **18 weeks**

Whole course: 1,070 h ÷ 40 h/week = **26.75 weeks**, about 27 weeks

Sense-check: 12 + 6 = 18 weeks, and Module I (350 h = 8.75 weeks) brings it to 26.75. Holidays, revision and assessment weeks make the calendar time longer.

1.3 The Greened Curriculum

Your curriculum is "greened". Every unit asks for eco-friendly materials, energy-efficient tools, low-emission finishes and careful waste handling. For a joiner this means everyday habits:

- **Use legal timber.** Buy plantation cypress, pine and blue gum from licensed yards and keep the receipts. Ask where any hardwood came from; prefer certified or reclaimed timber.
- **Cut efficiently.** Plan cutting lists and sheet layouts so less timber and board ends up as waste (Chapter 4).
- **Choose safer finishes and glues.** Water-based glues and low-VOC (low-solvent) finishes protect you, the client and the air.
- **Make things last.** Strong joints, seasoned timber and good finishes mean fewer replacements.
- **Sort and reuse waste.** Clean offcuts become handicrafts and small products, sawdust becomes briquettes, and hazardous waste goes to a licensed collector.

Recycling timber waste into handicrafts and consumer goods is a performance criterion in several units. Chapter 2 teaches it in full, and every chapter has a "Green tip".

> **GREEN TIP**
>
> Before you buy timber, ask for the yard's receipt and look at the ends of the boards. Fresh, wet ends and a heavy feel mean the timber is not dry, whatever the seller says. Wet timber shrinks and twists after it is made into a door, so the "cheap" boards cost you a remake and the waste that goes with it.

1.4 How You Will Be Assessed

Your course follows competency-based education and training (CBET): you prove you can do the job to industry standard, mostly with your hands while an assessor watches and asks questions. The Level 3 guide, Chapter 1, explains units, elements and performance criteria. Here is the outline; Chapter 16 gives the full rules.

- Each unit is assessed **formatively** (during training, against every performance criterion) and **summatively** (at the end, mainly practical, on the critical tasks).
- Unit score = 60% formative + 40% summative. Practical work carries most of the marks; the theory-to-practical split is one of the document points listed in Chapter 16 (Table 16.2), so check the current split with your assessor.
- Ratings: 80–100 Attained Mastery; 65–79 Proficient; 50–64 Competent; 49 and below Not Yet Competent. "Y" records assessment malpractice or irregularities.
- You work **individually**, in a real or simulated workplace, with the processes, equipment, materials, instructions and deadlines of a real job. Inspection and quality control follow National Construction Authority (NCA) standards. Evidence comes from practical tasks, projects, written tests, your portfolio and third-party reports.
- Your assessor is licensed by TVETA as a trainer and registered by TVET CDACC to assess the unit; an industry expert registered by TVET CDACC may also assess.

TVET CDACC issues a **Certificate of Competency** for each core unit you pass, a **Statement of Attainment** for a certifiable element, and the **Kenya National TVET Certificate in Carpentry and Joinery Level 4** when you pass every unit. Recognition of prior learning (RPL) can lead to part or all of the qualification, which helps practising fundi wa mbao who learned on the job.

> **WORKED EXAMPLE 1.2: WEIGHTED UNIT SCORE**
>
> Wanjiru's formative marks in Timber Furniture Items average 72. Her summative mark is 61. What is her unit score and rating?
>
> Unit score = 0.6 × formative + 0.4 × summative
>
> = 0.6 × 72 + 0.4 × 61 = 43.2 + 24.4 = **67.6**
>
> 67.6 lies in the 65–79 band, so she is rated **Proficient**.
>
> Sense-check: the score must lie between 61 and 72, nearer to 72 because formative carries more weight. It does.

1.4.1 Where the marks are

Each element carries marks in the PC weighting tool, and every unit adds up to 100, so marks read as percentages (Figure 1.4). Four lessons stand out. **Fixing** rough carpentry members carries half of Rough Carpentry. **Joints** carry 40% of Doors and Windows, **assembly** 40% of Timber Furniture Items, and **cutting out** 40% of Cabinets Construction. Floors and frames together carry 33 + 27 = 60% of Timber Floors and Framed Structures. Finishing carries only 10 marks in three units, yet a client judges the whole product by its finish, so finish well anyway.

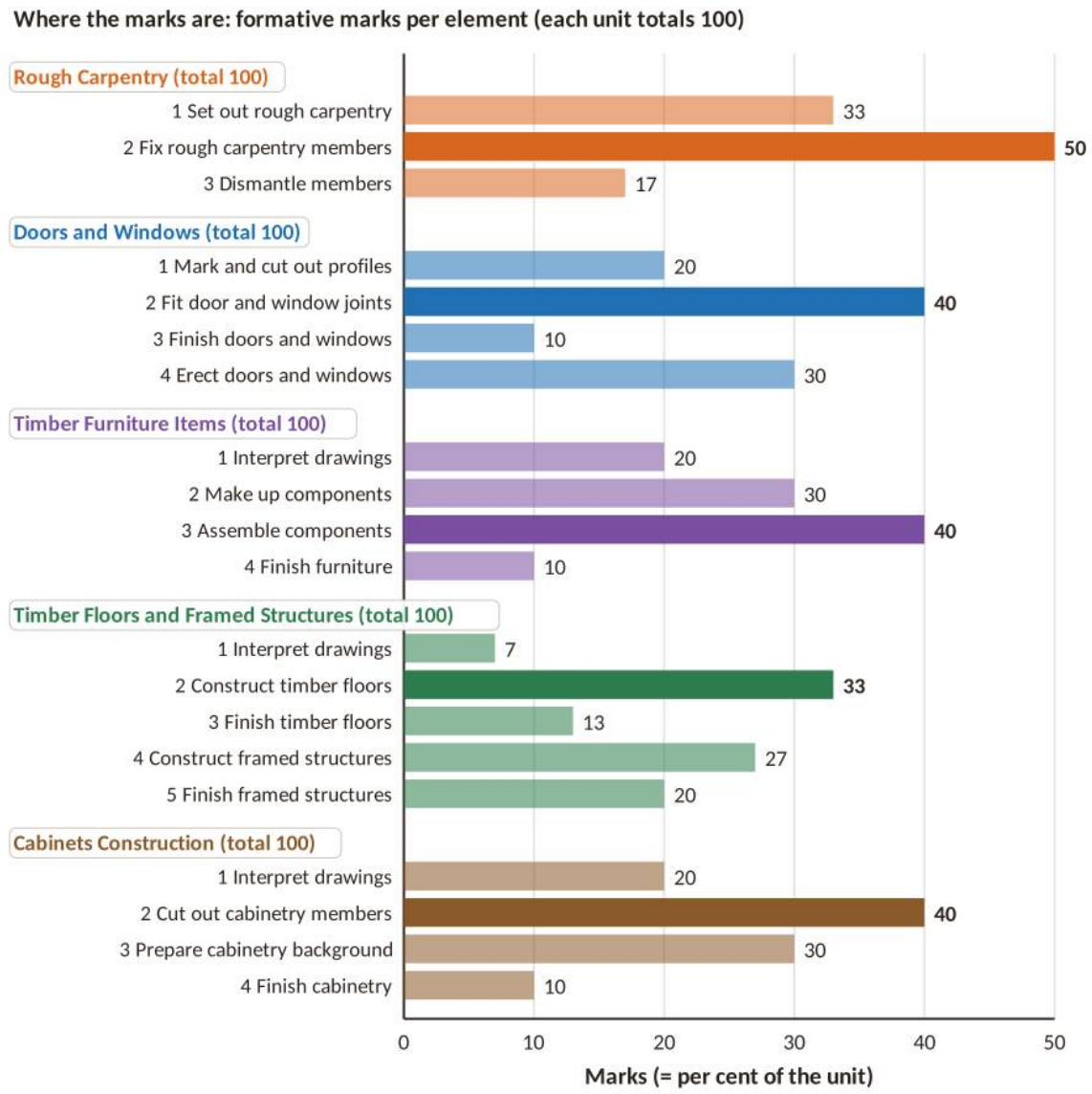


Figure 1.4 Where the marks are in formative assessment, element by element. Every unit totals 100, so the marks read as percentages.

WORKED EXAMPLE 1.3: MARKS TO A RATING

In a formative assessment of Doors and Windows, Kiprono gains 16 of 20 (marking and cutting out), 34 of 40 (joints), 9 of 10 (finishes) and 22 of 30 (erecting). What is his total and rating, and where did he lose most?

Total = 16 + 34 + 9 + 22 = **81 of 100**, so 81%.

81 lies in the 80–100 band: **Attained Mastery**.

Marks lost: 4, 6, 1 and 8. Erecting lost most (8 of 30), so he should practise hanging and fixing.

Sense-check: 100 − (4 + 6 + 1 + 8) = 100 − 19 = 81. It agrees.

1.5 Carpentry and Joinery in Kenya Today

Building is busy across Kenya. The Affordable Housing Programme needs doors, frames, wardrobes and kitchens by the thousand. Counties and schools tender for desks, lockers, beds and timber classrooms. Lodges and timber cottages go up in Naivasha, Nanyuki and the Mara, and apartment blocks in every town need kitchens and wardrobes. In towns you see iron-sheet hoardings along the roads and eucalyptus-pole scaffolds on storey buildings. Most timber is cypress and pine from Kenya Forest Service (KFS) plantations, sold by the running foot at yards in Kikuyu, Ruaka, Eldoret, Nakuru, Molo and Elburgon. Much joinery is still made in jua kali sheds, often with one table saw and a generator for the power cuts (Figure 1.5).

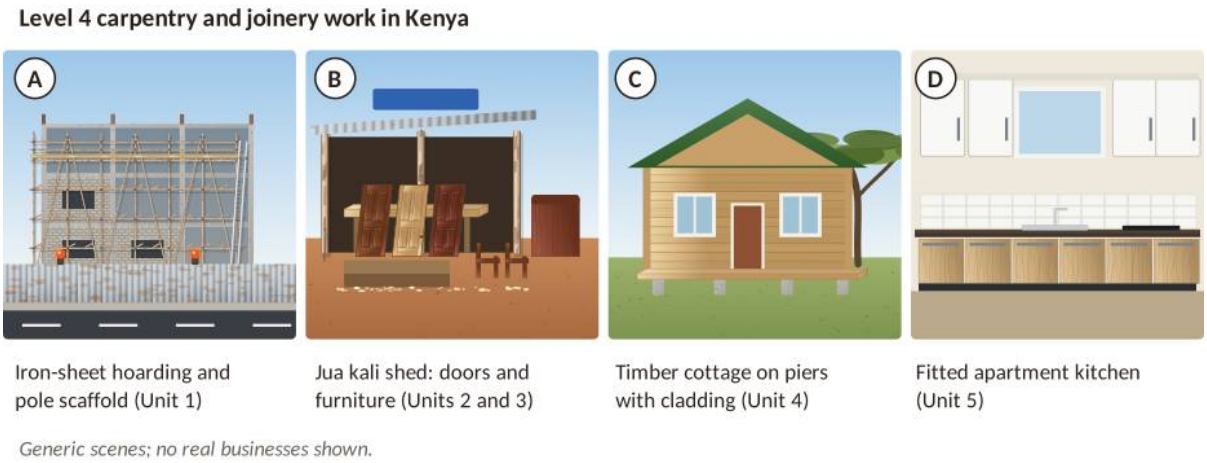


Figure 1.5 Level 4 work across Kenya: a site hoarding and pole scaffold (A), a jua kali joinery shed (B), a timber lodge cottage (C) and a fitted apartment kitchen (D).



Figure 1.6 A young carpenter assembling a sofa frame and melamine-faced cabinets outside a small roadside workshop: the furniture and cabinet work of Units 3 and 5. He is drilling without eye protection; wear goggles whenever you drill (Chapter 2).

Photo: Maina Pat Mbae, CC BY-SA 4.0, via Wikimedia Commons

1.5.1 The rules you work under

The **National Building Code 2024** is Kenya's current building code. It came into force on 1 March 2025 and is enforced by the **National Construction Authority (NCA)**; county governments approve plans and inspect work. Its parts on floors and roofs refer to Kenyan and Eurocode timber standards, and it requires ventilation under suspended timber floors (Chapter 13). Other bodies you will meet are **KFS** (plantations, licences and movement permits for timber), **NEMA** (waste and air quality), **DOSHS** under the Occupational Safety and Health Act 2007, **KEBS** (standards) and your county (approvals and hoarding permits on road reserves). Indigenous forests are protected; hardwoods such as mvule and meru oak are over-exploited and rare, so always ask for legal origin.

> **ON SITE IN KENYA**
>
> A contractor in Nakuru orders 30 internal doors for an apartment block and buys cheap cypress "straight from the sawmill". The Level 3 fundi starts cutting at once. The Level 4 joiner first checks the boards with a moisture meter: 24%, far above the 10–14% expected for indoor joinery. She stacks them on stickers under cover, explains the delay to the contractor in writing, and starts the doors when the timber is ready. Three months later, her doors still close; the neighbouring block's doors have twisted. Chapter 3 explains moisture content.

1.6 Your Career at Level 4

Figure 1.7 shows the ladder from Level 3 to Level 6 and the specialisms that open at Level 4. An employed Level 4 carpenter and joiner in Kenya typically earns about KSh 30,000–60,000 a month (an estimate; it varies by town and employer). Many open their own workshops, which Chapter 16 covers.

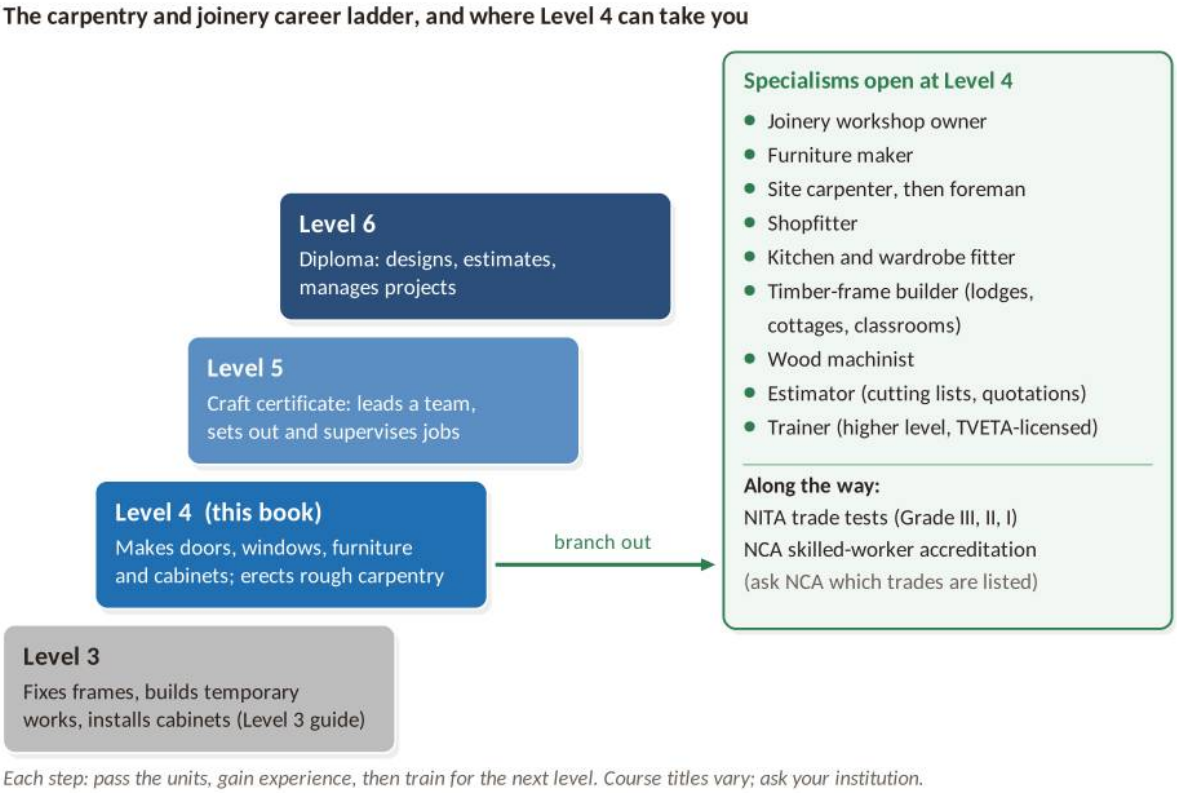


Figure 1.7 The carpentry and joinery career ladder from Level 3 to Level 6, and the specialisms a Level 4 carpenter and joiner can branch into.

Three steps add value to your certificate. **NITA trade tests** (Grades III, II and I) are well known to employers; ask NITA or your trainer about the current carpentry test. The **NCA** accredits skilled construction workers (the card currently costs KSh 1,000 and lasts three years); ask NCA whether your trade class is listed. A **portfolio** of dated photos of your doors, furniture and site work shows clients what you can do.

1.7 Working Professionally

At Level 4 people judge you on how you work as well as on what you make.

- **Clients.** Explain the design, the timber, the price and the delivery date in plain words. Put agreements in writing, with a sketch.
- **Architects and engineers.** Follow their drawings and specifications. Ask in writing when something is unclear; never change a design, a shore or a scaffold without approval.
- **Contractors and other trades.** Agree when openings, walls and services will be ready, and protect finished joinery from masons and painters.
- **County and NCA inspectors.** Keep work open for inspection, and keep scaffold inspection records ready.
- **Juniors.** Show, watch, then let them try. Check their PPE and machine authorisation first.

Use your phone well. Photograph every stage, from the rod and the joints to the finished, hung door; these photos go into your portfolio and protect you if a client complains later. Cutting-list and sheet-layout apps and a simple spreadsheet save hours. WhatsApp quotations are common; make them professional, with your name, the date, an itemised list, the validity period and the payment terms.

> **COMMON MISTAKES**
>
> - Thinking Level 4 is "more of Level 3". It adds making, machining and structural site work, with higher risks.
> - Cutting into timber before checking its moisture content and legal origin.
> - Rushing the finish because it carries few marks. Clients and assessors see it first.
> - Leaving the portfolio to the end of the course instead of filing evidence the same day.

1.8 How to Use This Book

Each chapter opens with what you will learn and the unit, learning outcome and hours. Key words come first; boxes mark safety, green tips, trainer's tips, common mistakes, Kenyan site examples and worked examples. Practical tasks end with a "Record your results" table for your portfolio. Each chapter closes with a summary, a competence checklist and ten practice questions; answers with full working are at the back. Values in this book are **typical examples**; figures with example values carry the note "Example — follow the drawing and the maker's instructions". On a real job you follow the drawing, the engineer or supervisor and the maker's instructions. Prices change; this book uses approximate 2026 figures.

> **TRAINER'S TIP**
>
> Start your Level 4 portfolio today with six dividers: the five units and industrial training. Every rod, cutting list, quotation, inspection record and dated photo goes behind the right divider the same day. Assessors trust a portfolio that grew week by week.

SAFETY FIRST

The Level 4 workshop has machines that can take a finger in a second. On your first visit, look but do not switch on, adjust or touch any machine. You may use a machine only after your trainer has shown you, watched you and authorised you, and then only with its guards in place and the right PPE (Chapter 2).

Practical task 1.1: Know your Level 4 workshop

Tools and equipment

- Dustcoat or overall and safety boots
- Clipboard, pen and the record sheet below
- Phone camera
- Steel tape measure

Materials

- Workshop layout sketch (A4)
- Portfolio file with six dividers

Steps

1. With your trainer, walk round the workshop with every machine switched off and isolated.
2. At each machine, find and note the guard, the riving knife (saws), push sticks or push blocks, the emergency stop, the isolator and the dust extraction.
3. Find the benches, cramps and assembly area, and the finishing area with its ventilation.
4. Find the timber and board storage and note how it is stacked.
5. Find the scaffold, trestle and tower equipment and where it is stored.
6. Find the PPE store, first-aid box, eye-wash point, fire extinguishers and fire exits.
7. Mark everything on your sketch with its condition, and report anything unsafe to your trainer.
8. Photograph the layout, date the photo and file it with this sheet in your portfolio.

Safety

- Do not switch on, adjust or lean on any machine during this task.
- Keep clear of anyone working; stay behind the walkway line.

Record your results

Item	Location	Guards and safety devices present	Condition / safety notes
Table saw			
Band saw			
Planer-thicknesser			
Mortiser			
Dust extractor			
Benches and cramps			
Finishing area and ventilation			
Timber and board storage			
Scaffold and tower equipment			

Item	Location	Guards and safety devices present	Condition / safety notes
PPE, first aid and fire points			

Chapter summary

- A Level 4 carpenter and joiner makes doors, windows, furniture and cabinet members, builds floors and frames, erects and dismantles rough carpentry, and guides juniors.
- This book covers Module II (480 h) and industrial training (240 h as the unit table gives): 720 h. Module I is in the Level 3 guide; the whole course is 1,070 h and 107 credits.
- The five units are Rough Carpentry, Doors and Windows, Timber Furniture Items, Timber Floors and Framed Structures, and Cabinets Construction.
- Unit score = 0.6 × formative + 0.4 × summative; practical work carries most of the marks; 50 is Competent and 80 is Attained Mastery.
- Fixing, joints, assembly and cutting out carry the biggest elements; finishing carries few marks but sells the product.
- The National Building Code 2024, enforced by the NCA, is the current code; buy legal timber and keep receipts.
- Work professionally, photograph every stage and keep your portfolio up to date.

Check your competence

- [ ] I can name the five Level 4 units with their codes and hours.
- [ ] I can explain why the course is 1,070 hours but the new Level 4 work is 720 hours.
- [ ] I can calculate a weighted unit score and give the rating.
- [ ] I can say which element carries most marks in each unit.
- [ ] I can name the current Kenyan building code and the body that enforces it.
- [ ] I can explain what "greened" means in a joinery workshop.
- [ ] I can describe three specialisms open to a Level 4 carpenter and joiner.
- [ ] I can locate each machine's guards, emergency stop and isolator in my workshop.

Practice questions

1. Name the five Level 4 units, with their codes and hours.
2. The Level 4 units and industrial training add up to 720 hours, but the course total is 1,070 hours. Explain the difference.
3. Your evening class trains for 30 hours a week. How many weeks will the 480 hours of Level 4 units take?
4. Oral: what is the difference between a Certificate of Competency, a Statement of Attainment and the Kenya National TVET Certificate in Carpentry and Joinery Level 4?
5. Otieno's formative average in Rough Carpentry is 70. What summative mark does he need to reach Proficient (65)? Could he still reach Attained Mastery?
6. In a formative assessment of Cabinets Construction a trainee gains 16 of 20, 28 of 40, 21 of 30 and 5 of 10 in the four elements. Give the total and the rating. Which element lost most marks, and how many more marks would give Attained Mastery?
7. Which element carries the most marks in each Level 4 unit, and what does this tell you about how to spend your practice time?
8. Fault-finding: a client in Eldoret complains that (a) the new cypress panel door you supplied in the dry season now sticks at the head and the lock side, and (b) the dining table rocks on her level floor. Give a likely cause of each and the chapter of this book that deals with it.
9. Oral: name the current Kenyan building code and the body that enforces it, and give three things a "green" joiner does on every job.
10. Practical: complete Task 1.1, then set up your Level 4 portfolio. List two pieces of evidence you will file behind each of the six dividers.

PART 3

Doors and Windows

Unit 2: Doors and Windows (CON/CU/CAJ/CR/02/4/MB, 120 hours). Door and window types and parts, rods, cutting lists and marking out in pairs; the woodworking machines taught in depth; the joinery joints, adhesives and glue-up; finishing timber surfaces; and hanging doors, fitting windows, locks and ironmongery, architraves and the final checks.

Chapter 7: Door and Window Construction: Types, Setting Out and Machining
Chapter 8: Joinery Joints: Fitting and Assembling Doors and Windows
Chapter 9: Finishing Timber Surfaces
Chapter 10: Hanging and Erecting Doors and Windows

CHAPTER 7

Door and Window Construction: Types, Setting Out and Machining

WHAT YOU WILL LEARN

- Name the types of doors and windows, their parts and how each is built and weathered.
- Work out leaf sizes from a frame and turn a full-size rod into a cutting list and cut plan.
- Mark out stiles and rails in pairs: sight lines, mortises, haunches, grooves and profiles.
- Set up and use the table saw, band saw, surface planer, thicknesser, mortiser and router safely, with every guard in place.
- Follow the machining sequence for a panel door and check the parts against tolerances.
- Cut machine energy costs and look after machines and cutters.

Unit: Doors and Windows · CON/CU/CAJ/CR/02/4/MB · Learning outcome 1 · About 44 hours

At Level 3 you fixed frames that a joinery shop had made. Now you are the joinery shop. Marking and cutting out door and window parts carries 20 of the unit's 100 marks, and every later mark depends on it: a badly machined stile cannot make a good joint. This chapter covers door and window types, setting out from a rod, and the woodworking machines, taught here once in depth. The job is the Eldoret front door (2,100 × 900 × 45 mm), whose rods you met in Chapter 3.

Key words

Stile
An upright outer member of a door or sash; the hanging stile carries the hinges, the closing stile the lock.

Rail
A cross member: top, frieze, lock (middle) and bottom rails.

Muntin
An upright member between rails that divides panels.

Sash
A glazed frame that opens or slides in a window frame; a casement is a hinged sash.

Horn
Extra length left on a stile beyond the rail to stop the end splitting; cut off after glue-up.

Sight line
The line where a rail's edge meets the stile, seen on the finished face.

Riving knife
A curved steel plate just behind a saw blade that stops the kerf closing and pinching the blade.

Bridge guard
The adjustable cover over the cutter block of a surface planer.

Hollow-chisel mortiser
A machine that cuts square holes with an auger turning inside a hollow square chisel.

Feed direction
The way the work moves past a cutter: always against its rotation.

7.1 Types of Doors and How They Are Built

Figure 7.1 shows the doors and windows of the unit in the timber you will meet in Kenyan workshops. The construction decides the joints, the cutting list and the price.



Figure 7.1 Door and window types in the unit. Doors (top): ledged, ledged and braced, and framed, ledged and braced (braces slope down to the hinge side), four-panel, half-glazed, flush and double doors. Windows (bottom): side-, top- and bottom-hung casements, vertical sliding sash and louvre.

7.1.1 Batten doors

A **ledged** door is a row of tongued, grooved and V-jointed boards nailed to three horizontal ledges. It is cheap but sags, so it suits stores. A **ledged and braced** door adds two braces between the ledges. The braces must slope **down towards the hinge side**, so each one is pushed into the hinge corner and holds the closing edge up. Fit them the other way and they pull out as the door drops. A **framed, ledged and braced** door adds stiles and a top rail jointed with mortise and tenon; the Eldoret back door in Chapter 4 (Figure 4.5) is one. Its middle and bottom rails are thinner than the stiles, so the boards run over them on the outside.

7.1.2 Framed (panel) doors

A framed door has two stiles, rails and usually muntins, with panels held in grooves. Common Kenyan patterns are two-, four- and six-panel doors; the six-panel door adds a frieze rail between the top rail and the lock rail. The joints are haunched mortise and tenons, wedged through the stiles, or dowels in factory work (Chapter 8). Panels may be solid timber, raised and fielded (thick in the middle, thinned at the edges), or plywood. They are never glued in: they float in the grooves with about 2 mm clearance so that they can move (Chapter 3, section 3.10). A **glazed** door replaces panels with glass held in rebates by beads, and may have glazing bars. Use the glass the drawing names; doors and low panes need safety glass.

7.1.3 Flush doors

A flush door has a light softwood frame covered on both faces with 3–6 mm plywood, hardboard or MDF skins. A **hollow-core** door has a cellular or ladder core between the skins; a **solid-core** door is filled with blockboard or particleboard and resists sound and forced entry better. Every flush door needs a **lock block** glued inside the frame where the lock will go, and **lipping**: solid strips glued to the edges so that they can be planed and hinged. The Eldoret bungalow's five internal doors are flush doors.

7.1.4 External, internal and double doors

External leaves are 44–50 mm thick, internal 35–40 mm (typical); external doors get a weatherboard and are sealed on all faces and edges. Double doors meet at **rebated meeting stiles**, so no light or rain passes; the first-closing leaf is held by flush or tower bolts. Fire doors are made and fitted only to the tested specification on the drawing, with matching frame, hinges, seals and closer. A joiner never alters a fire door.

Table 7.1 Door types, construction and use (typical; follow the drawing)

Type	Main parts and joints	Typical use
Ledged; ledged and braced	V-jointed T&G boards, ledges, braces housed into ledges; nailed and clenched or screwed	Stores, outbuildings, gates
Framed, ledged and braced	Stiles and top rail with through tenons; thinner rails and braces; boards tongued into stiles	Back and kitchen doors, workshops
Panel (two-, four-, six-panel)	Stiles, rails, muntins; haunched M&T or dowels; panels float in grooves	Front doors, quality internal doors
Glazed (half or fully)	Panel construction with rebates, beads, glazing bars; safety glass	Living rooms, shop fronts, offices
Flush (hollow or solid core)	Light frame, core, skins, lock block, lipping	Bedrooms, toilets, housing projects

7.2 Windows and Their Parts

Window **frames** (head, jambs, sill, mullion, transom) were covered in the Level 3 guide, Chapter 12. Level 4 makes the opening parts. A **casement** is a hinged sash: side-hung, top-hung (an awning, often used as a high vent) or bottom-hung (a hopper, which opens inwards at the top). Most Kenyan timber casements open outwards, so the rebates are on the outside face and burglar bars can go inside. A **vertical sliding sash** window has two sashes running past each other in the frame, balanced by cords and weights or springs; you will repair more than you make. A **louvre** window has glass or timber blades held in carriers that turn together, giving air even in heavy rain. **Fixed lights** are glazed straight into the frame.

A window must shed water. Figure 7.2 (B) shows how: the sill top is **weathered** (sloped out at about 1:8 to 1:10), a **drip groove** under the sash bottom rail and a **throating** under the sill nose make drops fall off instead of running back into the wall, and the sash closes against a stop in a rebate. Sash members are typically 44 mm thick, with a rebate for the glass and a bead or putty to hold it.

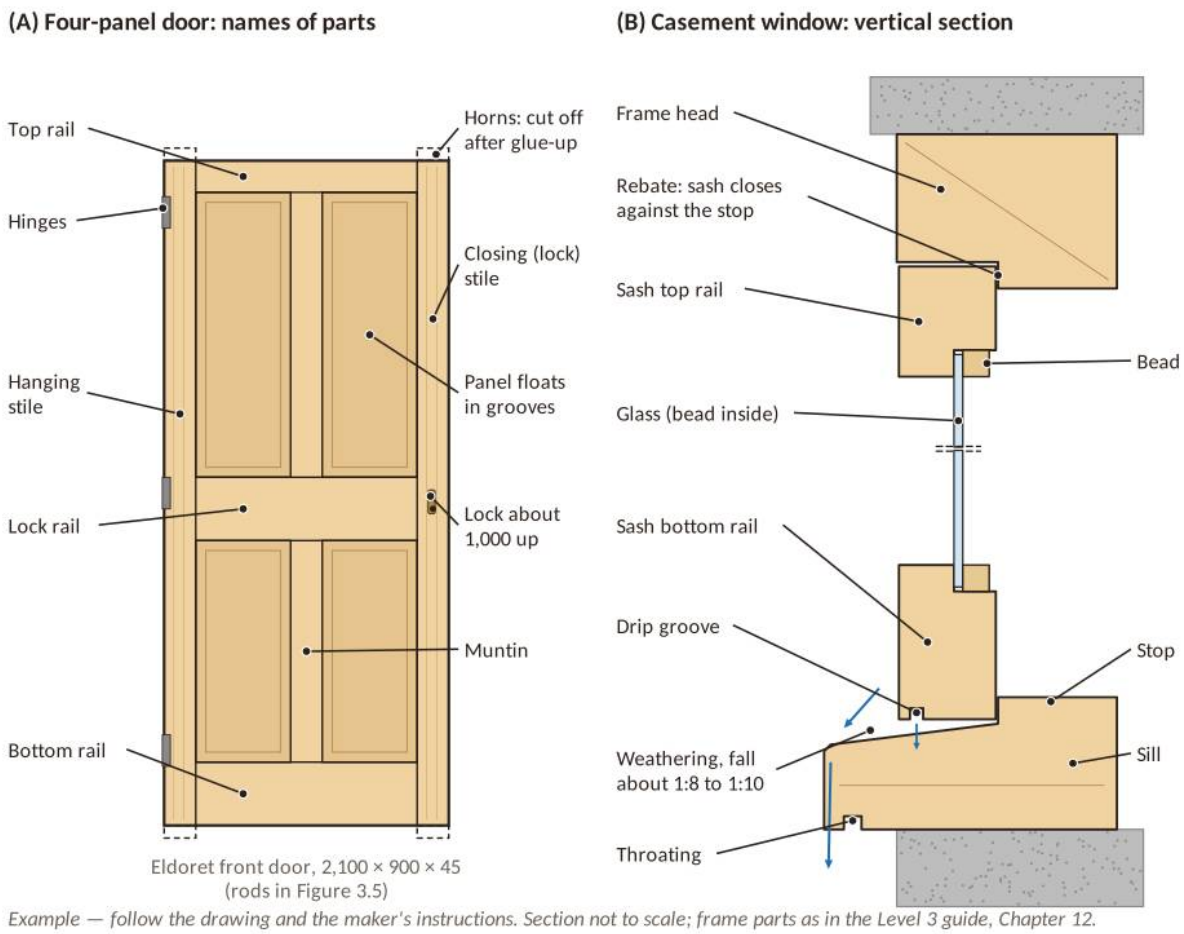


Figure 7.2 (A) Parts of a four-panel door, on the Eldoret front door layout. (B) Vertical section through an outward-opening casement window: rebates, glazing bead, drip groove, sill weathering and throating shed the rain.

7.2.1 Materials by use

Choose as in Chapter 4: straight, dry cypress (10–14% moisture content) for internal doors and sashes; the best heartwood or a durable hardwood of legal origin for external doors, sills and bottom rails; plywood or MDF for panels and flush skins; treated pine only where it will be painted and kept dry. Choose ironmongery before setting out: a mortice lock or a parliament hinge can change the stile width or rebate.

7.3 Setting Out

7.3.1 Leaf sizes from the frame

When the frame is already built in, measure the opening between the rebates at the top, middle and bottom, and use the smallest. Take off the hanging gaps: about 2–3 mm at the head and each side, and a floor gap that suits the floor finish (Level 3 guide, Chapter 14).

WORKED EXAMPLE 7.1: A REPLACEMENT DOOR FOR AN EXISTING FRAME

An older house in Eldoret town needs a new four-panel door. The opening between rebates measures 913 mm wide and 2,108 mm high (smallest readings). Gaps: 3 mm each side, 3 mm at the head, 3 mm at the floor (tiled floor; the floor finish decides).

Leaf width = 913 − 2 × 3 = **907 mm**.

Leaf height = 2,108 − 3 − 3 = **2,102 mm**.

Stile cut length = leaf height + 2 horns = 2,102 + 2 × 40 = **2,182 mm**.

Rail cut length (through tenons) = leaf width + 2 × 5 mm to trim = 907 + 10 = **917 mm**; between shoulders = 907 − 2 × 100 = 707 mm with 100 mm stiles.

Sense-check: the leaf is 6 mm narrower and 6 mm shorter than the opening, which is the total of the gaps. Plane the final fit when hanging (Chapter 10), not now.

7.3.2 From the rod to the cutting list

Draw the height and width rods full size before you buy timber (Chapter 3, Figure 3.5). Every part, joint and allowance is read off them: stile lengths with horns, rail lengths over the tenons, muntins with stub tenons into the rails, and panel sizes. Panel size = sight size + 2 × (groove depth − clearance); for the front door that is 300 + 2 × (12 − 2) = 320 mm wide. Table 7.2 is the front door's cutting list, and Worked example 7.3 prices it with the Chapter 4 method.

Table 7.2 Cutting list for the Eldoret front door, from the rods (example layout, 45 mm finished thickness)

No.	Part	No. off	Finished L × W	Cut L × W	Notes
1	Stile	2	2,100 × 100	2,180 × 106	Horns 40 each end; through mortises
2	Top rail	1	900 × 100	910 × 106	Haunched, wedged through tenons
3	Lock rail	1	900 × 200	910 × 206	Double tenons; grooved both edges
4	Bottom rail	1	900 × 200	910 × 206	Double tenons, haunched
5	Muntin, bottom	1	760 × 100	770 × 106	700 sight + 2 stub tenons of 30
6	Muntin, top	1	960 × 100	970 × 106	900 sight + 2 stub tenons of 30
7	Panels, 12 mm	2 + 2	320 × 720; 320 × 920	As finished	Float in 12 × 12 grooves

WORKED EXAMPLE 7.3: STOCK AND COST FOR THE STILES, RAILS AND MUNTINS

Finished widths of 100 and 200 mm need sawn widths of at least 106 and 206 mm, so buy cypress **9x2 (225 × 50 mm)** at KSh 140 per ft. Two 106 mm strips plus one 4 mm kerf = 216 mm, which fits in 225 mm. Choose full-sized 2-inch boards that clean up to 45 mm.

Board A, 12 ft (3,658 mm): cross-cut 2,180 mm and rip it into the two stiles. Rip the remaining 1,474 mm into two strips: top muntin 970 (offcut 500) and top rail 910 (offcut 560).

Board B, 10 ft (3,048 mm): lock rail 910 + bottom rail 910 + bottom muntin 770 + two kerfs = 2,598 mm, leaving 446 mm. Rip the rails to 206 and the muntin to 106.

Stock = 12 + 10 = **22 ft** (6.71 m). Cost = 22 × 140 = **KSh 3,080**.

Sense-check: the finished parts hold 0.0469 m^3; the boards bought hold 22 × 0.3048 × 0.225 × 0.050 = 0.0754 m^3, a 62% yield. The rest is horns, planing, kerfs and offcuts, which go to wedges, beads and the offcut rack.

7.3.3 Marking out in pairs

Plane every part to size first, then mark out. Put face-side and face-edge marks on each piece (Level 3 guide, Figure 5.4). Lay the two stiles side by side on the height rod with their face edges together, and square the sight lines across both at once with a knife and try square (Figure 7.3). Mark rails the same way on the width rod. Working in pairs guarantees that the stiles match even if the rod is a millimetre out.

- **Mortises**: set the mortise gauge's pins to the mortise chisel (15 mm for a 45 mm door), not to a rule, and gauge from the face side only.
- **Haunches**: mark the haunch socket at the outer end of each top and bottom rail mortise, to the depth of the groove.
- **Grooves and rebates**: gauge from the face side so that every panel lines up.
- **Profiles**: a chamfer, ovolo (quarter-round with fillets) or bead on the arris round each panel is marked with a gauge line; where profiles meet at a joint they are scribed or mitred (Chapter 8).
- **Tools**: marking, mortise and cutting gauges, sliding bevel, combination square, scriber, chalk line, carpenter's pencil and a sharp marking knife for shoulder lines.

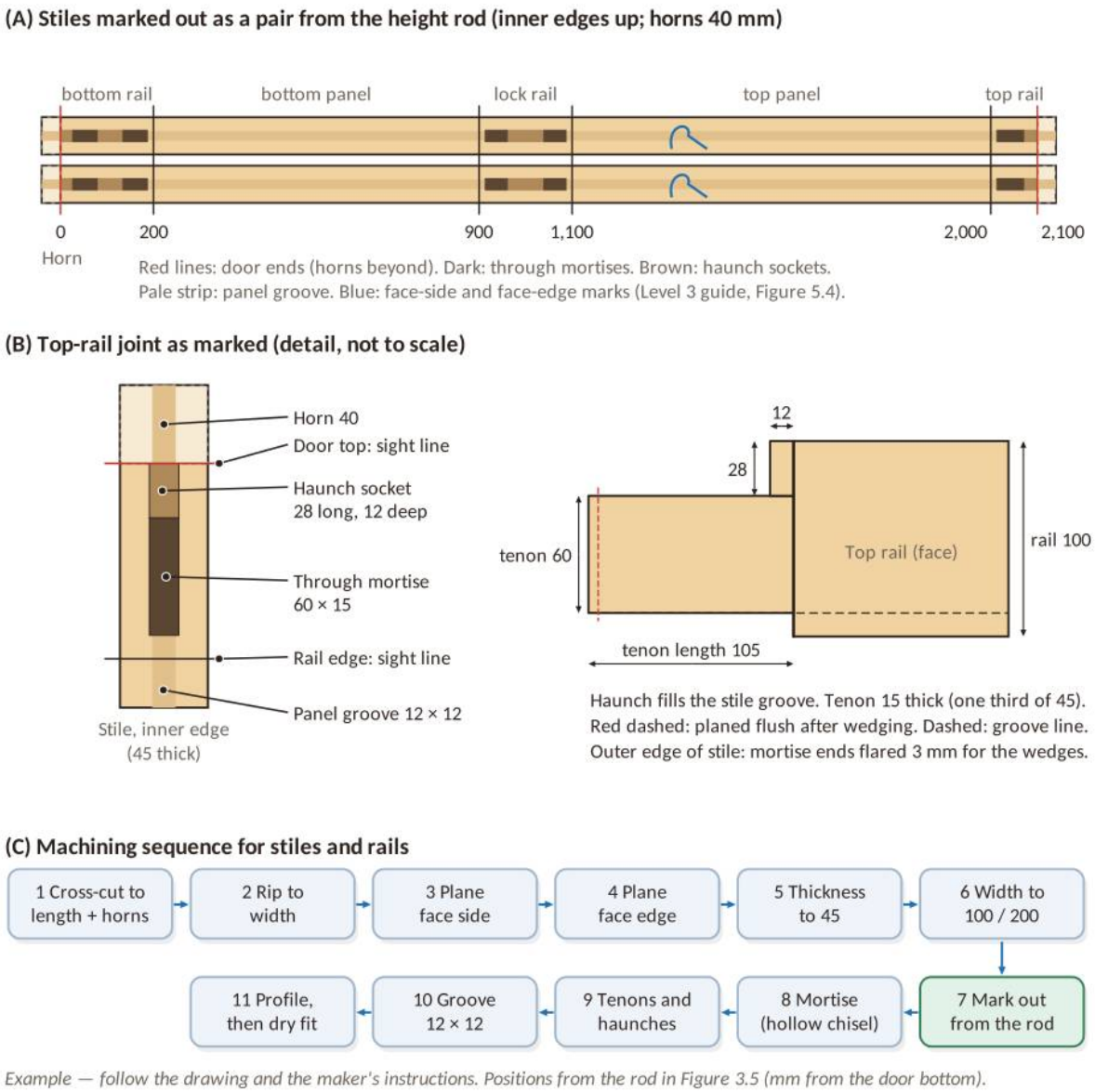


Figure 7.3 From the rod to machined parts on the Eldoret front door: (A) the stiles marked as a pair from the height rod; (B) the top-rail joint as marked, with its 15 mm haunched through tenon; (C) the machining sequence.

7.4 Woodworking Machines

Chapter 2 (section 2.4) gave the general rules: authorised users only, guards in place, push sticks, isolate before adjusting, no gloves near blades, extraction on, and ear protection, because most of these machines are louder than 85 dB(A) (Figure 2.5). This section teaches each machine. Figure 7.4 shows the machines found in a well-equipped VTC or joinery workshop; many jua kali shops have a combination machine that does several jobs from one table, with the same guards.

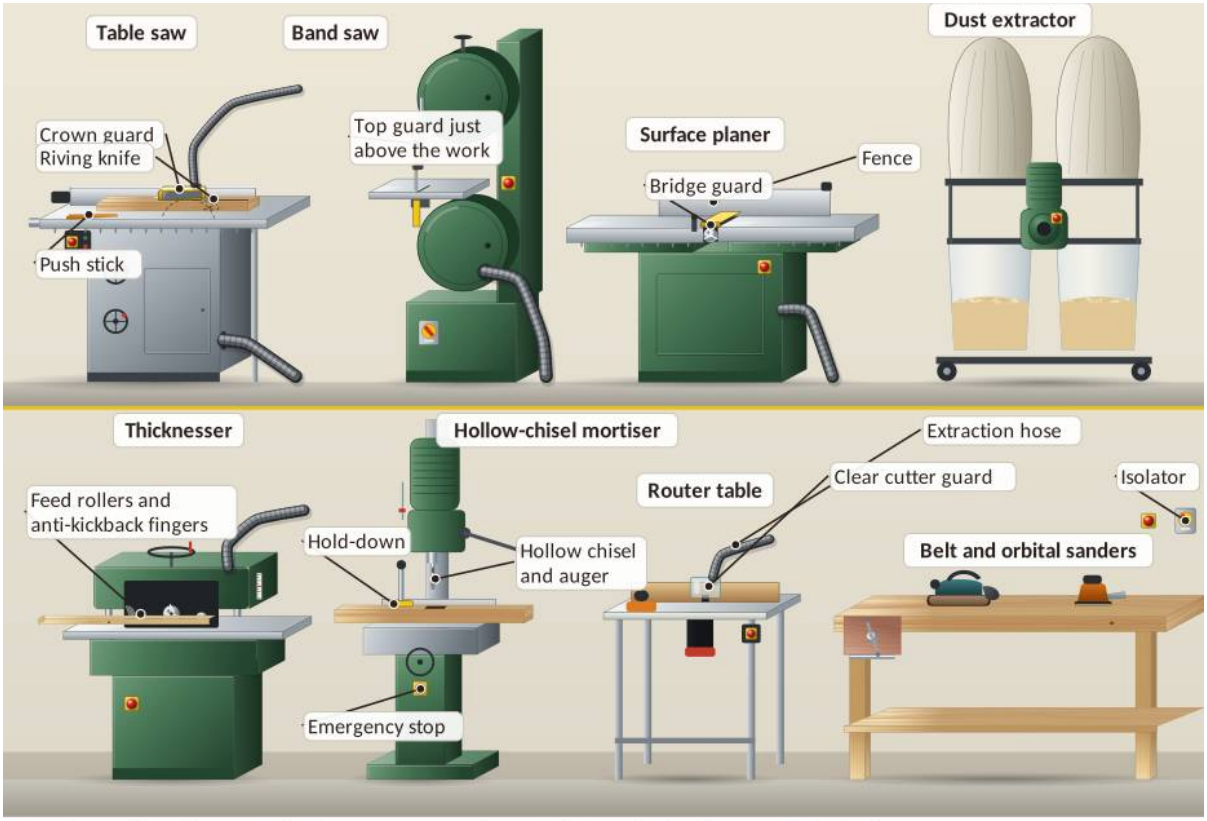


Figure 7.4 Joinery machines in a VTC workshop, with their guards: table saw, band saw, surface planer, dust extractor, thicknesser, hollow-chisel mortiser, router table and bench sanders.

Safe stance and habits. Stand balanced, feet apart, to one side of the blade line. Keep both hands on the work or the push aid, never across or behind the blade. Let the machine reach full speed before feeding and stop fully before you reach in. One operator controls the machine; an outfeed helper only supports the work, never pulls it. Set machines while isolated, then test the set-up on an offcut.

Table 7.3 Machine set-up and checks (typical; the maker's manual rules)

Machine	Main jobs	Guards and aids	Key settings and checks
Cross-cut / dimension saw	Cutting to length, squaring ends, sheets	Blade guard, sliding table, length stop	Blade square to the table and fence; stop set from the rod
Table saw	Ripping, small cross-cuts, grooves (with the right guard)	Riving knife, crown guard, push stick, rip fence	Blade about 10–15 mm above the work; knife close behind the blade; sharp blade
Band saw	Curves, re-sawing, tenon cheeks	Top guard and guides, lower guard	Top guard just above the work; blade tension and tracking
Surface planer	Face side and face edge	Bridge guard, push block, fence	Light cut; outfeed table level with the knives; minimum length about 300 mm
Thicknesser	Thickness and width, parallel to the faces	Anti-kickback fingers, enclosed cutter	Light passes; one piece at a time; part longer than the roller spacing
Hollow-chisel mortiser	Mortises and haunch sockets	Hold-down, chisel guard, fence	Chisel square to the fence; 1–2 mm gap between auger and chisel tip; depth stop
Router (hand-held or table)	Grooves, rebates, profiles, hinge housings	Cutter guard, fence, push block	Feed against the rotation; shallow passes; cutter tight in the collet

7.4.1 Cross-cutting and dimension saws

Cut stock to rough length first, with horns and allowances, on a dimension saw with a sliding table, a cross-cut saw with a length stop, or a mitre saw. Hold the work against the fence, keep the offcut free to fall away, and never cross-cut against the rip fence on a table saw: the piece jams between fence and blade and is thrown back. If you must use the rip fence for repeat lengths, clamp a spacer block to it, ahead of the blade.

7.4.2 The table saw

The table saw rips timber to width (Figure 7.5). Before work, with the saw isolated: check the blade for sharp, unbroken teeth; set the **riving knife** close behind the blade (follow the maker's gap) and at about blade height; set the blade about 10–15 mm above the work; lower the **crown guard** onto the work; set the rip fence parallel to the blade and lock it. Use a rip blade (fewer, larger teeth) for solid timber and a fine panel blade for boards. Feed with steady pressure against the fence, change to a **push stick** before your hand comes within about 150 mm of the blade, and push the piece right past the riving knife. Support long boards at the outfeed with a roller stand. Grooving or rebating on a table saw needs a special guard and is done only with your trainer's permission.

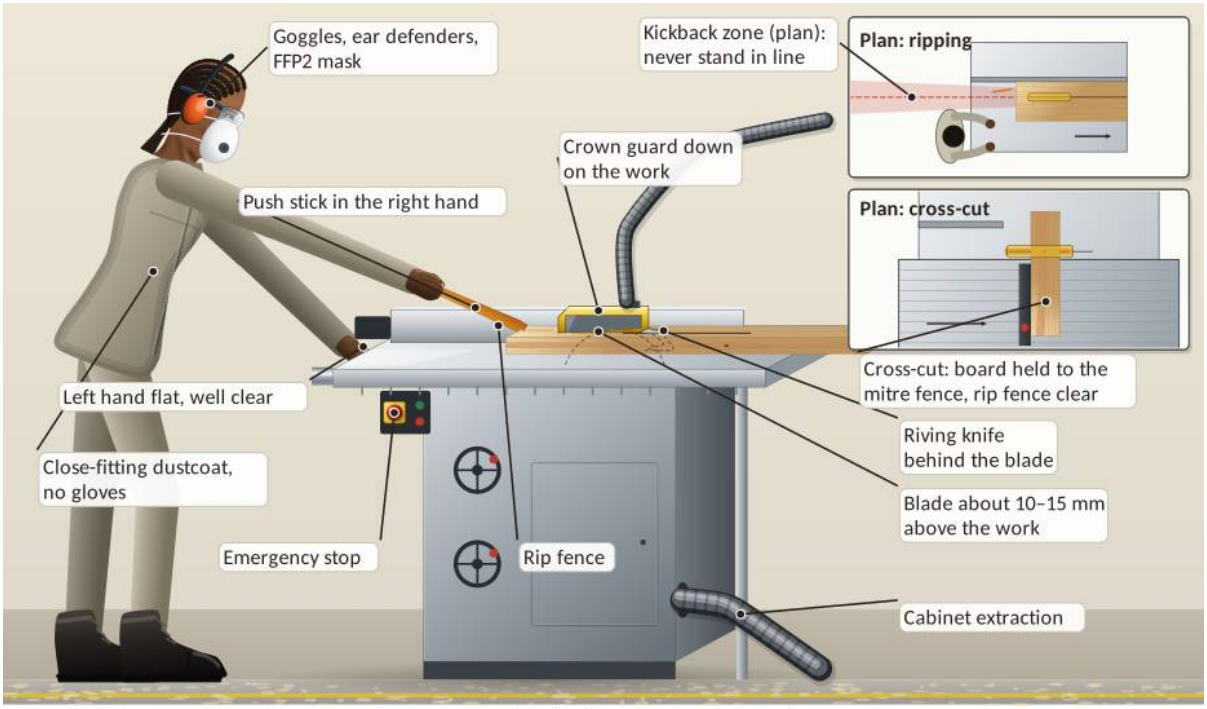


Figure 7.5 Ripping on the table saw: blade just above the work, riving knife behind it, crown guard down, push stick in the right hand, left hand flat and clear, full PPE and no gloves. Insets (plans): stand to one side of the kickback zone; cross-cut against the mitre fence with the rip fence clear.

> **SAFETY FIRST**
>
> **Kickback** happens when the back of the blade lifts the work and throws it at the operator. Causes: no riving knife, a blunt blade, a board that is twisted or case-hardened and closes on the blade, feeding too fast, cross-cutting against the fence, or standing in line with the blade. If a board binds, do not pull it back: hold it still, press the emergency stop with your knee or free hand, wait until the blade stops, isolate, then free it. Rip twisted boards on the band saw instead.

7.4.3 The band saw

The band saw cuts curves (arched head rails, brackets) and re-saws thick boards. Set the top guard and guides just above the work so only the cutting part of the blade is exposed. Use a narrow blade for tight curves with relief cuts on sharp bends, never back out of a long cut with the machine running, and use a push stick for narrow pieces. A clicking sound means a cracked blade: stop, isolate and report it.

7.4.4 The surface planer and the thicknesser

The **surface planer** makes the face side flat and the face edge square to it (Figure 7.6, A). Set a light cut; take the hollow side down so that the work rocks less; press on the outfeed side once the work has passed the cutter; keep the bridge guard just above the work for faces and close to the work for edges, and push the trailing end with a push block. Your hands never pass over the cutter block. Pieces shorter than about 300 mm are planed by hand.

The **thicknesser** then brings the work to thickness and width, parallel to the planed face (Figure 7.6, B). Put the face side down, take light passes, and feed one piece at a time, longer than the distance between the rollers. Stand to the side and never reach into the feed opening; if a piece stops, switch off and isolate before you lower the table. Snipe (a deeper cut at the ends) is reduced by supporting long pieces level at both ends; leaving horns on stiles hides it.

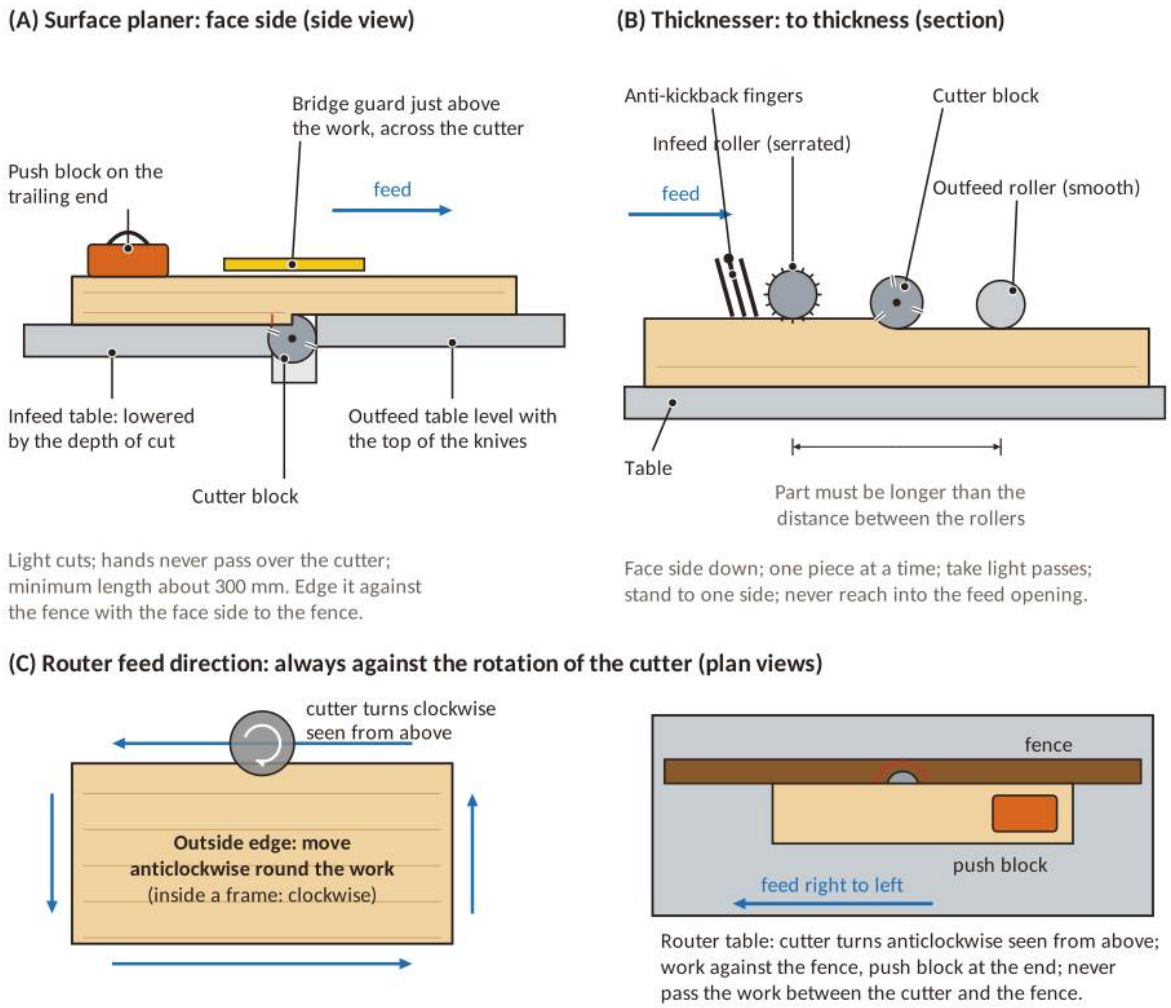


Figure 7.6 Machine set-ups: (A) surface planer, (B) thicknesser and (C) router feed direction, always against the rotation of the cutter.

7.4.5 The mortiser and tenoning

A **hollow-chisel mortiser** drives a square hollow chisel into the wood while an auger inside it clears the waste (Figure 7.7). Fit the chisel square to the fence, with a 1–2 mm gap between the auger's cutting spurs and the chisel points so that they do not rub and burn. Clamp the work under the hold-down, against the fence, face side to the fence. Set the depth stop. Cut the ends of the mortise first, then the waste between, in overlapping steps. For through mortises, cut from both edges to meet in the middle, so that neither face splits out.



Figure 7.7 A hollow mortise chisel and its auger. The auger turns inside the chisel and lifts the chips while the square chisel pares the corners.

Photo: SilentC, CC BY-SA 3.0, via Wikimedia Commons

Tenons are cut on a **tenoner** in factories, or in VTC shops with a **tenoning jig** that slides along the table saw fence and holds the rail on end, or by cutting the cheeks on the band saw and the shoulders on the cross-cut saw with a length stop. Cut one test tenon on an offcut of the same thickness, check its fit, then cut the set.

7.4.6 The router and the spindle moulder

The **router** cuts grooves, rebates, profiles and hinge housings. Hand-held, it is moved anticlockwise round an outside edge; on a router table, the work is fed right to left against the fence (Figure 7.6, C). Both rules keep the feed against the cutter's rotation, so the cutter does not grab and run. Take shallow passes, tighten the cutter fully in the collet with the router unplugged, and keep the guard over the cutter. The **spindle moulder** cuts the same profiles in long runs. It is a specialist machine with a high accident rate: use it only after separate training, with power feed or a jig, and never as a trainee on your own.

7.4.7 Sanders and dust extraction

Belt and orbital sanders finish flat parts before assembly; sand with the grain, bag or hose on, FFP2 mask on. Connect every machine to the extractor with the hose size the maker states; open the blast gate of the machine in use and close the others so the air speed stays high. Empty bags before they are full; never blow dust off with compressed air.

7.5 Machining the Front Door

The sequence in Figure 7.3 (C) is the same for every framed door or sash:

1. Cross-cut stock to rough length with horns; rip to width plus planing allowance.
2. Surface plane the face side, then the face edge square to it; mark both.

3. Thickness to 45 mm and run to width (100 or 200 mm), always with the face side down or the face edge on the fence.
4. Mark out from the rods in pairs.
5. Cut the mortises and haunch sockets, then the tenons and haunches.
6. Run the 12 × 12 mm grooves on the router table or with a grooving set-up, and the profiles last, so that their edges are not damaged.
7. Dry-fit the frame (Chapter 8) before any glue.

Quality checks after machining. Measure thickness and width at both ends and the middle with a rule or callipers: aim for ±0.5 mm on joint sizes and ±1 mm on lengths (Chapter 3). Check the face side for wind with winding sticks and the edge for square with a try square. Check mortises for square walls and full depth, tenons for a firm hand-push fit, and grooves for even depth. Record the sizes (Practical task 7.2).

> **TRAINER'S TIP**
>
> Machine one or two spare pieces of every section with the set. When a stile splits or a tenon is cut short, the spare is already the right size, and you do not have to set every machine up again.

7.6 Energy-Efficient Machining

Electricity is part of the prime cost (Chapter 4). Energy (kWh) = power (kW) × time (h); cost = kWh × KSh 30. The biggest savings come from habits: use the right machine for the cut, keep blades and knives sharp (blunt cutters draw more power and burn the wood), switch machines and the extractor off between jobs, and use battery tools on site instead of running a generator.

> **WORKED EXAMPLE 7.2: ELECTRICITY FOR ONE PANEL DOOR**
>
> Example ratings and running times (Figure 7.8): table saw 3.0 kW for 20 min; surface planer 2.2 kW for 25 min; thicknesser 3.0 kW for 20 min; mortiser 0.75 kW for 30 min; router table 1.6 kW for 25 min; dust extractor 1.5 kW whenever a machine runs, 120 min.
>
> Table saw: 3.0 × 20 ÷ 60 = 1.00 kWh. Planer: 2.2 × 25 ÷ 60 = 0.92 kWh. Thicknesser: 1.00 kWh. Mortiser: 0.75 × 30 ÷ 60 = 0.38 kWh. Router: 1.6 × 25 ÷ 60 = 0.67 kWh. Extractor: 1.5 × 120 ÷ 60 = 3.00 kWh.
>
> Total = **6.96 kWh**. Cost = 6.96 × 30 = **KSh 209** per door.
>
> Sense-check: the extractor alone uses 43% of the energy. Left running all day (8 h) it would use 1.5 × 8 = 12 kWh = KSh 360, so KSh 270 a day, or about KSh 5,940 a month, would buy nothing.

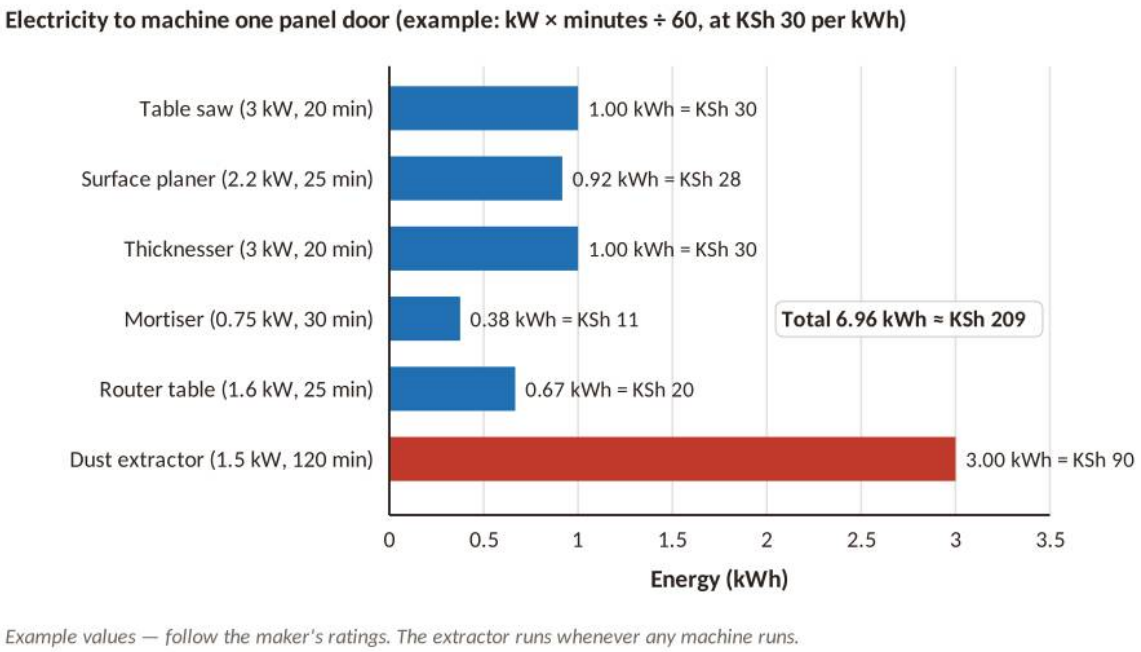


Figure 7.8 Electricity used to machine one panel door (Worked example 7.2, example ratings and times). The dust extractor uses the most because it runs with every machine.

GREEN TIP

Fit a switch or blast gate at each machine so the extractor runs only while a machine cuts. Send blunt blades and planer knives for sharpening on time. Sawdust and shavings from untreated timber go to briquettes or animal bedding; offcuts from the cut plan become wedges, beads and handicrafts. A small idea from door offcuts: a row of coat pegs on a planed cypress board (Chapter 2, section 2.10.4).

7.7 Working Without Machines

Many jua kali shops and rural sites have no three-phase power. The same door can be made with the Level 3 hand tools (Level 3 guide, Chapter 4): rip and panel saws, jack and try planes, mortise chisel and mallet, tenon saw and plough plane. The rules do not change: plane and mark in pairs from the rod, gauge from the face side, saw on the waste side. A portable circular saw on a guide rail and a hand-held router, on an RCD-protected or battery supply, speed up the slow steps.

7.8 Caring for Machines and Cutters

Daily: clean resin off tables and fences, check guards and the emergency stop, and sweep up. Weekly: check belts, blades and fence squareness, and wax the tables. Blades, planer knives and router cutters are sharpened by trained staff or a specialist sharpening service; a trainee replaces a planer knife only under supervision, with the machine isolated and the knife set to the maker's gauge. Lock out and tag a faulty machine and record it in the logbook.

ON SITE IN KENYA

A Kericho workshop won a school tender for 80 classroom doors. The owner set each machine once and ran each operation for the whole batch: all the cross-cutting, then all the planing, then all the mortises. Two trainees with length stops and a marked rod machined the stiles and rails in four days, and every door matched. One set-up per operation saved hours of resetting.

COMMON MISTAKES

- Fitting ledged-and-braced door braces the wrong way, so they pull out as the door drops.
- Gluing panels into their grooves, so they split in the dry season.
- Marking stiles one at a time from a tape instead of in pairs from the rod.
- Thicknessing before planing a face side, so the twist is copied into both faces.
- Ripping without a riving knife, or cross-cutting against the rip fence.
- Feeding a router with the rotation, so it grabs and runs.
- Leaving the extractor and idle machines running between jobs.

Practical task 7.1: Set out a door rod and a cutting list

Tools and equipment

- Rod board (planed board or hardboard strip) as long as the door
- Rule, try square, marking gauge, sharp pencil, calculator

Materials

- Drawing of a four-panel or ledged and braced door from your trainer
- Cutting-list form (Chapter 4)

Steps

1. Read the drawing and check the leaf size against the frame or opening (Worked example 7.1).
2. Draw the height rod full size: rails in section, grooves, panels, horns and sight lines.
3. Draw the width rod: stiles and muntins in section, with grooves and panel clearances.
4. Mark the joint positions: mortises, haunches and tenon lengths.
5. Take off a cutting list with finished and cut sizes and number every part.
6. Plan the stock on a cut plan and cost it (Chapter 4). Ask your trainer to check the rod.

Safety

- Bench task. Carry rod boards on edge; keep them off the floor and away from machines.

Record your results

Rod check	Value on rod	Drawing	OK (✓) or query
Leaf height / width			
Rail widths and positions			
Groove and panel sizes			
Horns and tenon lengths			
Cutting list complete and costed			

Practical task 7.2: Machine a set of stiles and rails

Tools and equipment

- Cross-cut saw, table saw, surface planer, thicknesser (as authorised)
- Push sticks and push blocks, rule, callipers, try square, winding sticks

Materials

- Cypress for two stiles and three rails (your cutting list)
- Machining record (below)

Steps

1. Do the pre-use check on each machine with your trainer, with the machine isolated.
2. Cross-cut to rough length with horns; rip to width plus about 6 mm.
3. Plane the face side and face edge; mark them.
4. Thickness to the finished size, then run to width, face side down.
5. Cut to final length from the rod; measure every piece and record it.
6. Clean the machines, empty the extractor and sort offcuts.

Safety

- Goggles, ear defenders, FFP2 mask, close-fitting clothes, no gloves. Guards and riving knife in place; push sticks within about 150 mm.
- Work only on the machines you are authorised for, with your trainer present.

Record your results

Part	Target T × W × L	Measured T	Measured W	Measured L	Square / wind OK?
Stile 1					
Stile 2					
Rail 1					
Rail 2					
Rail 3					

Chapter summary

- Batten doors are boards on ledges (braces sloping down to the hinge side); framed doors have stiles, rails, muntins and floating panels; flush doors have a frame, core, skins, lock block and lipping.
- Windows shed water with weathered sills, drips, throatings and rebates; casements may be side-, top- or bottom-hung.
- Leaf size = opening between rebates − gaps; stiles get horns; rails are cut over their tenons.
- Everything is read from full-size rods; parts are planed first, then marked in pairs from the face side and face edge.
- Each machine has its own guards and settings: riving knife and crown guard, top guard, bridge guard, anti-kickback fingers, hold-down; push sticks and blocks; feed against the rotation.
- Sequence: cross-cut, rip, face, edge, thickness, width, mark, mortise, tenon, groove, profile, dry fit.
- Energy = kW × hours; sharp cutters and switching off idle machines and the extractor save money.

Check your competence

- [ ] I can name and sketch the main door and window types and their parts.
- [ ] I can explain how a window sheds water.
- [ ] I can work out a leaf size from a frame opening and the cut lengths of its parts.
- [ ] I can take a cutting list from a rod and plan the stock.
- [ ] I can mark out stiles and rails in pairs, with mortises, haunches and grooves.
- [ ] I can carry out pre-use checks and set the guards on each machine I am authorised for.
- [ ] I can machine parts to size within tolerance and record the results.
- [ ] I can estimate the electricity cost of a job and reduce it.

Practice questions

1. Sketch a ledged and braced door hung on the left. Show which way the braces slope and explain why.
2. Name the parts of a four-panel door and say why its panels are not glued in.
3. Sketch a vertical section through a casement sill and bottom rail and label the weathering, drip groove and throating.
4. A frame opening measures 832 × 2,038 mm between rebates. Allow 3 mm at the sides and head and 5 mm at the floor. Find the leaf size, the stile cut length with 40 mm horns, and the rail cut length for through tenons.
5. A thicknesser rated 3 kW and the 1.5 kW extractor run for 45 minutes to thickness a batch of rails. Find the energy and the cost at KSh 30 per kWh.
6. List the pre-use checks on a table saw before ripping, with the machine isolated.
7. Why is the face side planed on the surface planer before the board goes through the thicknesser?
8. Oral: explain to a new trainee which way to feed a hand-held router round the outside of a table top, and why.
9. Fault-finding: a trainee's stiles came out of the thicknesser 1.5 mm thinner at the ends than in the middle, and one rail kicked back on the table saw. Give the likely causes and how to prevent each.
10. Practical: set out the rods and cutting list for a two-panel internal door 2,032 × 813 × 40 mm and machine its stiles to size (Tasks 7.1 and 7.2).

Enjoyed this sample?

This free sample of **Carpentry and Joinery Level 4** has the front matter, Chapter 1 and the full Chapter 7 on door and window construction: door and window types and parts, leaf sizes from the frame, full-size rods, cutting lists and cut plans, marking stiles and rails in pairs, and setting up the table saw, band saw, planer, thicknesser, mortiser and router safely, with every guard in place. The complete guide has **16 chapters** and **313 pages**. It covers all five Level 4 units (Rough Carpentry, Doors and Windows, Timber Furniture Items, Timber Floors and Framed Structures and Cabinets Construction) plus the industrial training: hoarding, shoring and scaffolds; joinery joints, glue-up and finishing; hanging doors, ironmongery and architraves; tables, chairs, beds and TV stands; suspended floors, parquet, timber frames and cladding; kitchen members, cutting patterns, backgrounds and laminating; and costing every job in KSh.

It also includes 128 realistic illustrations, diagrams, charts and photos, 55 worked examples, 32 practical tasks with record sheets, 160 practice questions with full answers, five mock assessments, a 219-term glossary, a quick reference of typical values and formulas, and photocopiable logbook, cutting-list, machine-check and snagging sheets.

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