MINISTRY OF EDUCATION
TECHNICAL TEACHERS
ASSOCIATION OF GHANA

Building Construction & Woodwork Technology

(Applied Technology)

for Senior High Schools

Year 3

Michael Korblah Tsorgali
Isaac Buckman
Frank Fabian Aidoo

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FOREWORD

Ghana's new Senior High School Curriculum aims to ensure that all learners achieve their potential by equipping them with 21st Century skills, knowledge, character qualities and shared Ghanaian values. This will prepare learners to live a responsible adult life, progress to further studies and enter the world of work. This is the first time that Ghana has developed a Senior High School Curriculum which focuses on national values, attempting to educate a generation of Ghanaian youth who are proud of our country and can contribute effectively to its development.

The Ministry of Education is proud to have overseen the production of these Learner Materials which can be used in class and for self-study and revision. These materials have been developed through a partnership between the Ghana Education Service, teacher unions (Ghana National Association of Teachers-GNAT, National Association of Graduate Teacher -NAGRAT and the Coalition of Concerned Teachers- CCT) and National Subject Associations. These materials are informative and of high quality because they have been written by teachers for teachers with the expert backing of each subject association.

I believe that, if used appropriately, these materials will go a long way to transforming our Senior High Schools and developing Ghana so that we become a proud, prosperous and values-driven nation where our people are our greatest national asset.

Haruna Iddrisu MP
Minister for Education

SECTION

1

SERVICES IN BUILDING AND WOODWORK MACHINES

UNIT 1

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

Building services are the systems and equipment that make buildings safe, comfortable, and functional for the people who use them. These services include heating, ventilation, air conditioning (HVAC), lighting, water supply, drainage, fire protection, and electrical systems. They are essential in both residential and commercial buildings, helping to create healthy and efficient environments. Without proper building services, even the most beautifully designed structure would be difficult to live or work in. Engineers and technicians work together to design, install, and maintain these systems, ensuring they meet safety standards and operate efficiently. As technology advances, building services are becoming smarter and more sustainable, using energy-saving solutions and automation. Understanding building services is key to appreciating how modern buildings work and how they support everyday life. Whether you're studying construction, engineering, or architecture, building services are a vital part of the built environment.

In year two, you studied excavation, which is closely linked to this lesson on reasons for providing building services. Excavation is part of the services provided in the construction of the substructure of a building. This present lesson will enrich your knowledge and understanding of excavation as an important aspect of building services.

KEY IDEAS

- Services are important systems provided in buildings.
- Services include control systems for lighting, energy, comfort and safety.

SERVICES IN BUILDING CONSTRUCTION

Building services in construction encompass the mechanical, electrical, and plumbing (MEP) systems that ensure a building is functional, safe, and comfortable for occupants. These systems include heating, ventilation, and air conditioning (HVAC), lighting, power distribution, plumbing, fire protection, and communication networks, which are clearly illustrated in the breakdown of Table 1.1.1 below.

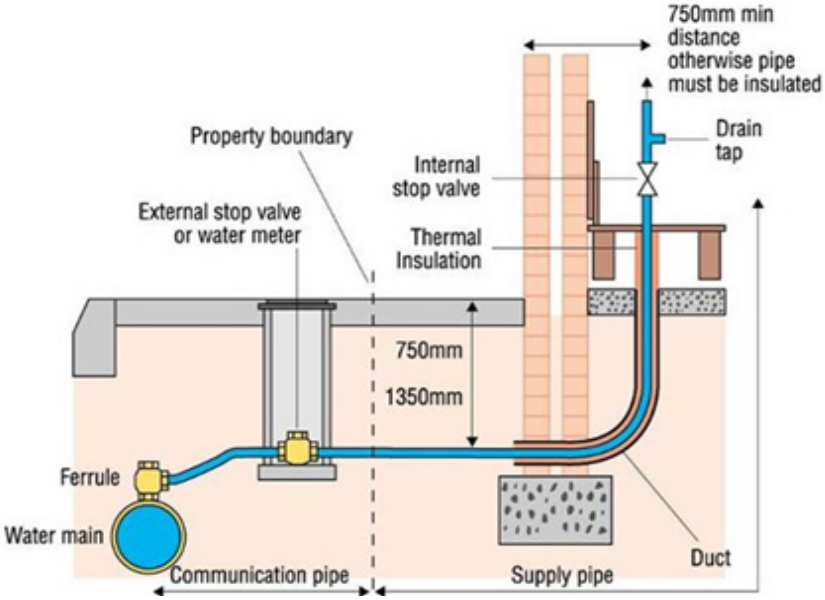
Table 1.1.1: *Detailed breakdown of the various systems/services as used in building construction*

SERVICES IN BUILDING CONSTRUCTION	DESCRIPTIONS OF SERVICES / SYSTEMS
Mechanical Systems	• HVAC (Heating, Ventilation, and Air Conditioning): Controls the indoor temperature and air quality. • Refrigeration: Used for cooling and maintaining specific temperature levels, often in commercial and industrial settings. • Specialist Systems: May include systems for bacteria and humidity control, fume cupboards, and other specialised needs.
Electrical Systems	• Power Distribution: Provides electricity for lighting, appliances, and other electrical equipment. • Lighting: Ensures adequate and appropriate illumination for different areas of the building. • Communication and Security Systems: Includes data networks, communication infrastructure, and security systems like alarms and surveillance. • Specialised Systems: Can include emergency power, specialised lighting, and other custom electrical needs.
Plumbing Systems	• Water Supply: Delivers potable water for various uses within the building. • Drainage and Sewage: Removes wastewater and sewage from the building. • Fire Protection Systems: Involves fire alarms, sprinklers, and other systems to detect and suppress fires.
Other Essential Services	• Vertical Transportation: Includes elevators and escalators for moving people and goods between floors. • Building Control Systems: Integrate and automate various building systems for efficiency and optimisation. • Facade Engineering: May include systems for building shading and energy efficiency.

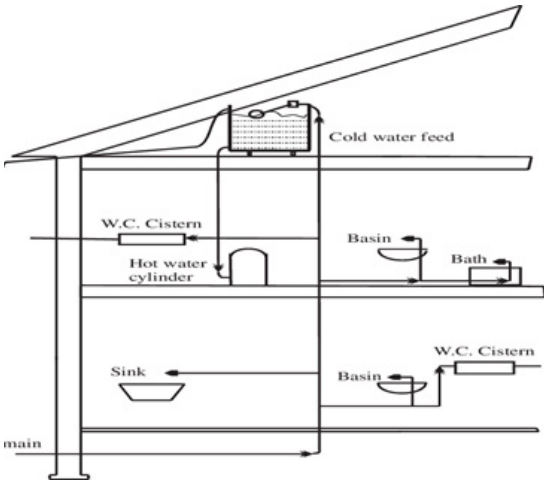
DIFFERENT TYPES OF SERVICES PROVIDED TO HOUSES IN BUILDING CONSTRUCTION

The type of services provided to houses in building construction is crucial for creating a comfortable, safe, and functional environment for building occupants, and their design and installations are integral parts of the overall construction process. These are outlined in ***Table 1.1.2***. Below are illustrations of ***Figures 1.1.1 to 1.1.4***.

Figure 1.1.1: Examples of Electrical installation services like fixing wires testing, electrical remedial works, electricity supply, lighting protection and circuit breaker installations.



Cold water supply to a house



(B) Direct cold water supply installation

Figure 1.1.2: Examples of cold-water supply to houses from the main line

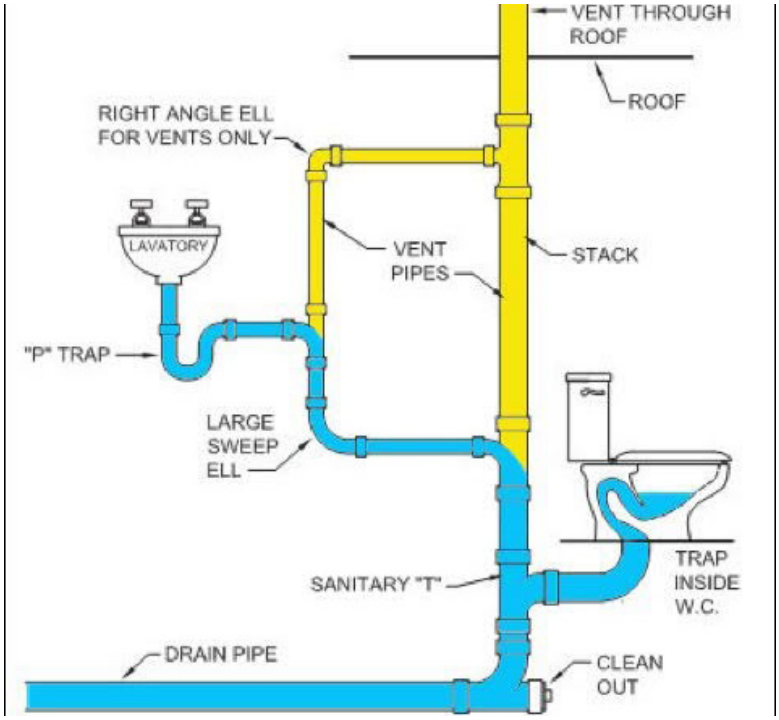
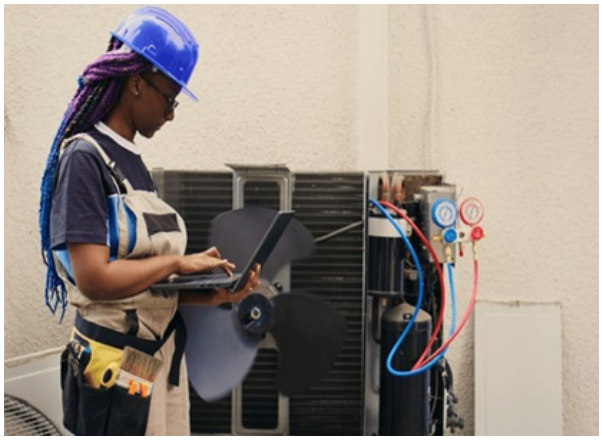


Figure 1.1.3: Example of foul or sewage pipe works



(A)
Testing and maintenance of the air conditioning

(B)
Installation of an air conditioner in a building

Figure 1.1.4: Examples of air conditioning supply services

Table 1.1.2: *Different types of services*

SERVICE	TYPES
Mechanical Services	**1.** HVAC (Heating, Ventilation, and Air Conditioning): Installing and maintaining systems for heating, cooling, and air quality. **2.** Plumbing: Installing water supply and drainage systems, including pipes, fixtures, and appliances. **3.** Fire Protection: Installing fire alarms, sprinklers, and other safety systems. **4.** Elevators and Escalators: Installing and maintaining vertical transportation systems.

Electrical Services	1. **Wiring**: Installing electrical wiring throughout the building to power lights, appliances, and other electrical systems. 2. **Lighting**: Installing fixtures and systems for interior and exterior illumination. 3. **Power Distribution:** Installing panels, transformers, and other equipment to distribute electricity safely. 4. **Low Voltage Systems:** Installing communication, security, and automation systems.
Plumbing Services	1. **Excavation:** Preparing the site for construction by digging foundations and other necessary trenches. 2. **Water Supply:** Installing pipes, fixtures, and appliances for potable and non-potable water. 3. **Drainage:** Installing pipes and systems for wastewater disposal. 4. **Gas Piping:** Installing gas lines for heating, cooking, and other appliances.
Specialised Installations	1. **Appliances:** Installing refrigerators, ovens, dishwashers, and other household appliances. 2. **Audio-Visual Systems:** Installing home theatres, sound systems, and other entertainment technologies. 3. **Security Systems:** Installing alarm systems, surveillance cameras, and access control.
Maintenance and Repairs	1. **Routine Maintenance:** Regularly inspecting and maintaining systems to ensure optimal performance. 2. **Repairs**: Addressing any issues with the building's systems or components. 3. **Renovations**: Re-modelling or upgrading existing structures and systems.

PURPOSES OF PROVIDING SERVICES IN BUILDINGS

Building services in projects are provided to serve and facilitate the entire process, from initial planning to the final stage of handover. These services are provided to ensure that the structures are built safely and efficiently to achieve the desired quality. These services involve a wide range of activities, including design, planning, procurement, construction, and project management, and are crucial for realising both residential and commercial building projects. ***Table 1.1.3 provides details of the Purposes for Providing Services in Building Construction.***

Table 1.1.3: *Purpose of providing services in building construction*

REASONS	DETAILS
Realising Architectural Visions	Building services transform design concepts into tangible structures, bringing architectural visions to life.
Ensuring Safety and Compliance	They prioritise safety standards and adherence to local regulations throughout the construction process.
Managing Complex Projects	Building services coordinate various stakeholders, subcontractors, and resources to ensure a smooth and efficient workflow.
Meeting Project Goals	They help projects stay on schedule and within budget, delivering the desired quality and functionality.
Enhancing Building Functionality	Building services, a subset of construction services, integrate essential systems like HVAC, plumbing, and electrical systems, contributing to the building's comfort, safety, and efficiency.
Providing Expertise and Specialised Skills	Building services offer specialised knowledge and skills in areas like structural engineering, electrical work, and mechanical systems.
Facilitating Effective Communication	They ensure clear and consistent communication among all parties involved in the project, minimising potential issues and delays.
Delivering Sustainable and Energy-Efficient Buildings:	Building services play a crucial role in designing and implementing sustainable and energy-efficient systems, contributing to the building's environmental performance.
Ensuring Smooth Handover and Maintenance:	Building services also include commissioning and handover procedures, ensuring the building is ready for occupancy and guiding future maintenance.
Supporting Building Lifespan:	Proper maintenance, facilitated by building services, can extend the lifespan of building systems and equipment, reducing long-term costs.

Activity 1.1.1 Investigating Services in Buildings and Their Purposes

Scenario: Imagine you are part of a **community-building design team** tasked with planning a new residential estate. Your team must decide which essential services (e.g., water supply, electricity, waste disposal, ventilation) should be included in the houses. You will **explain what each service is**, **identify the different types**, and **justify why each is important** for comfortable, safe living.

Materials Needed

- Chart paper and markers
- Service-related images (electricity lines, water tanks, drainage pipes, solar panels, etc.)
- Short video clips or brochures showing building services
- Sticky notes for brainstorming
- Reference materials (textbooks, supplier pamphlets)
- Internet-enabled devices (optional)

Activity Guidelines

1. Organise yourself into a group of 4-5 members.
2. You and your group members will first observe the provided images, videos, or brochures.
3. Write down what you think "services in buildings" means.
4. Share your personal definition with your group, then agree on one combined group definition.
5. As a group, list the main services you think should be in a house (electrical, plumbing, sanitation, communication, etc.).
6. Explain one service to the group, including:
   - **a.** What it is
   - **b.** The different types available
   - **c.** Its main purpose in a building
7. With your group, discuss why each service is important, thinking about:
   - **a.** Comfort
   - **b.** Safety
   - **c.** Hygiene
   - **d.** Convenience
8. Write two sentences explaining how the absence of your assigned service would affect residents.
9. Combine these into a group impact chart showing each service and its importance.
10. Visit at least one other group to compare lists of services.
11. Ask at least one question about a service they included that your group did not.
12. Add one new service or benefit learned from another group into your personal notes.

13. Return to your own group and update your chart with the new ideas.
14. With your group, present your service plan to the class. Every member of your group presents the service they personally researched.
15. Write answers in your notebook to the following:
    a. Which service do you think is the most important in a house and why?
    b. What was the most surprising new fact you learned today?
16. Take a photo of a building in your community and identify at least three visible services.
17. Write a short paragraph explaining how these services contribute to the residents' well-being.

Conclusion

Providing services in buildings is important because they ensure safety, comfort, health, and convenience for people. Services such as water, electricity, waste disposal, and ventilation make houses and communities functional and improve quality of life. Without them, living conditions would be difficult and unsafe.

EXTENDED READING

- Chudley, R., & Greeno, R. (1998). Building Construction Handbook (Third Edition). A division of Reed Educational and Professional Publishing Ltd. Woburn, MA 01801-2041. Pages: 399–401; 402–405.
- Hall, F., & Greeno, R. (2007). Building Services Handbook (Fourth Edition). Butterworth-Heinemann, Elsevier Ltd, Linacre House, Jordan Hill, Oxford OX2 8DP Pages: 1–3; 4–6.
- Jones, M., et al. (2022). Building Services Engineering for Construction. Hodder Education. www.hoddereducation.co.uk Pages: 2–5; 6–9.

REVIEW QUESTIONS

1. Evaluate the challenges of integrating contemporary building services into an old building you are renovating without compromising its design.
2. Analyse how building services contribute to the comfort of the user.

UNIT 2

WOODWORK TECHNOLOGY

TOOLS AND MACHINES IN THE WOODWORK INDUSTRY

Introduction

In this unit, you will learn to choose the right woodworking machine for woodworking tasks. Woodworking machines are machines designed for a specific operation, for example, machines designed for cutting, shaping, drilling, turning and smoothing wood. These machines must be matched to the job to work safely and efficiently. Knowing which machine to use saves time, prevents accidents and helps you produce sturdy, beautiful pieces. This skill builds your confidence in the workshop and unlocks your creative potential. By mastering machine selection, you honour the craft's traditions and prepare yourself for realworld projects.

In Year 2, you learned how to select and use the right machine for specific woodwork tasks. This unit builds on that knowledge by helping you choose the appropriate machine on your own. Now, you are expected to work more confidently and independently when selecting machines for cutting, shaping, drilling, or smoothing wood. This shows growth in your skills and prepares you for real workshop tasks.

KEY IDEAS

- Always check the machine's function before use to match it with the task.
- Be sure the machine can handle the material safely and efficiently.
- Choose machines based on the type of work (e.g., cutting, shaping, drilling).
- Decide on the correct machine by using knowledge of machine parts and how they operate.
- Ensure safety features are present and working before selection.
- Follow the correct procedure to operate the selected machine properly.

MACHINES FOR A SPECIFIC OPERATION

In woodworking, machines are made to carry out specific tasks with speed and accuracy. One such machine is the mortising or drilling machine, which is used to make holes, especially for joints.

Mortising/Drilling Machine

There are three main types of mortising machines: hollow chisel mortiser, chain mortiser, and horizontal slot boring machine. ***Table 1.2.1*** describes the various types with their features and specific uses.

a. Hollow Chisel Mortiser

The hollow chisel mortiser is used for making square or flat-bottomed mortises, especially stub mortises. It works slowly but accurately and is suitable for detailed work.

Features

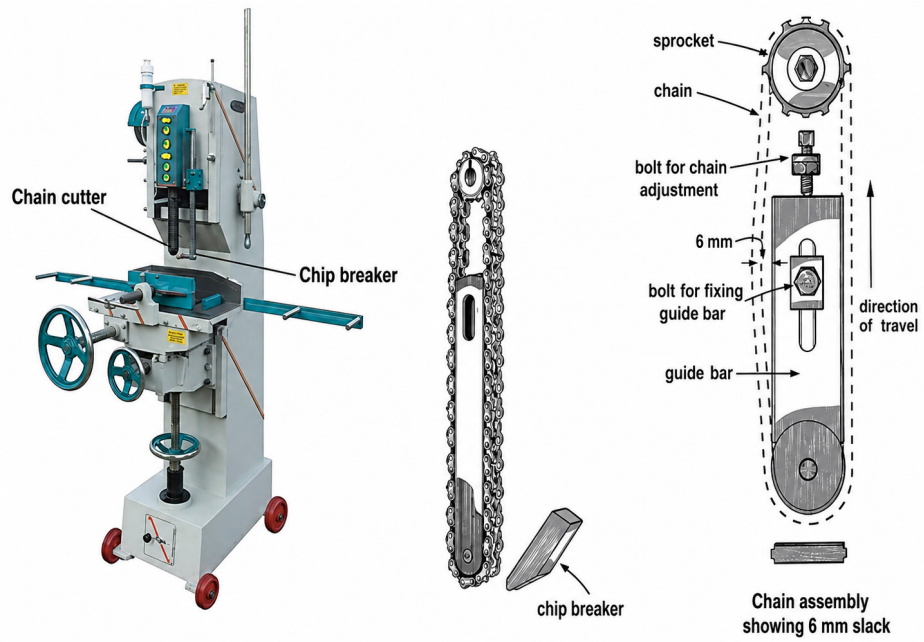
The hollow chisel mortiser has a chuck at the lower end of the cutter head to hold different sizes of auger bits and chisels. The auger bit spins inside the chisel, cutting most of the wood, while the chisel shapes the corners. The auger bit should stick out about 1–2 mm below the chisel. Wood chips are broken and carried out through flutes in the auger and a side hole in the chisel.

Specific Uses

The hollow chisel mortiser is ideal for cutting square mortises in fine joinery work. It is best used when clean, sharp corners are needed in shallow joints like stub mortises.

b. Chain Mortiser

The chain mortiser is a powerful machine used to cut deep mortises faster. It is best for heavy-duty woodwork but may cause splits at the end where the chain exits the wood.



Features

The chain mortiser uses a looped chain made of strong steel with sharp cutting edges angled at 25°. The chain should be properly tensioned with about 6 mm of slack in the center. It cuts with more speed and power than the chisel mortiser.

Specific Uses

The chain mortiser is suitable for cutting deep mortises in large timber and when speed is more important than precision. It is often used in construction or large furniture frames.

c. Horizontal Slot Boring Machine

This machine is used to cut small mortises using a horizontal bit. It provides accurate positioning and is useful for light-duty mortising tasks.

Features

The horizontal slot boring machine has a horizontal spindle with a chuck on one end to hold the bit. The machine has a table with two clamps to hold the wood in place. The table can move up and down and side to side to guide the wood onto the bit. It is operated by hand using a mechanical feed.

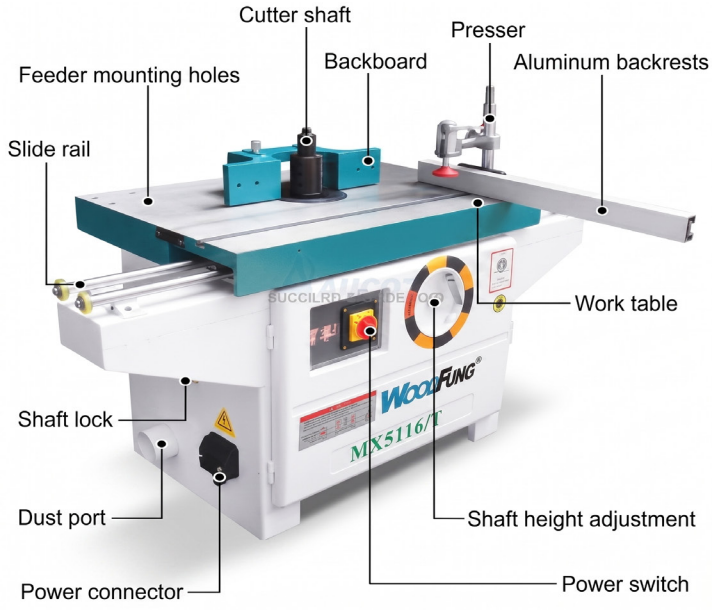
Specific Uses

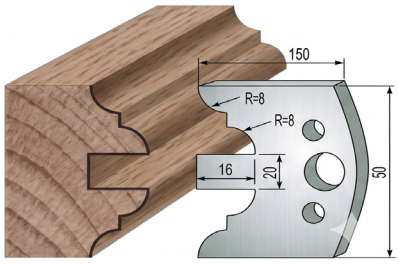
The horizontal slot boring machine is best for making small mortises in furniture joints, especially where precision is needed in the height and depth of the cut.

d. Spindle Moulder

Description with Diagram

The spindle moulder is a powerful woodworking machine used for shaping wood. It has a box-shaped, fully enclosed base that holds the motor, spindle shaft, rise and fall mechanism, and belt system. The motor drives the spindle using a short V-belt.





Features

The spindle moulder is a woodworking machine with a flat working table that includes holes and slots for attaching essential parts like fences, guards, and tooling systems.

It uses different types of cutters and cutter blocks, which are mounted vertically on a rotating spindle. These can be straight, curved, or profiled depending on the shape required.

The machine includes:

- A two-part straight fence for guiding straight-edge cuts. These are adjustable and usually aligned for accuracy.
- An eccentric ring fence for curved shaping work.
- A false fence or finger fence to reduce the open gap near the cutter, improving both safety and cutting precision.
- Lock nuts, clamps, and bolts to securely fix fences and accessories in place.
- Table slots and lock-down screws to hold accessories and guides firmly during operation.

Spindle speed is adjustable by shifting the belt and pulley system underneath the table, allowing different speeds for different cutter types and wood materials.

Correct tool selection and setup, including the type of cutter, fence arrangement, and safety fittings, are essential for efficient and safe operation.

Specific Uses

The spindle moulder is used to shape the edges of wood, create detailed designs, and prepare joints. It is ideal for making clean grooves, curves, and rebated edges. It is also useful for preparing furniture parts with smooth and decorative finishes.

Operations

Tasks the spindle moulder machine can perform include:

- Creating square or rectangular holes
- Cutting mortises for mortise and tenon joints
- Slotting or recessing for locks or fittings

With special attachments, it can also do:

- Tenoning
- Planing
- Trenching
- Recessing
- Lap and through dovetailing

e. Router Shaping Machine

Before crafting furniture or intricate woodwork, it is essential to understand the router shaping machine - a precision tool for creating smooth edges, joints, and designs. ***Table 1.2.3*** covers its description, features, specific uses and operations.

Description with Diagram

The Router shaping machine is a multi-purpose woodworking tool used to shape wood edges, make grooves, and add decorative patterns. It has a high-speed spinning head and a flat worktable that allows for precise cutting and shaping. The spindle can rotate at speeds up to 30,000 RPM for smooth, efficient work.

For purposes of learning, there are Modern routing setups which include:

- **Handheld Routers**: Versatile and portable for edge trimming, inlays, and joinery.
- **Router Tables:** Stationary setups where the router is fixed under a table, allowing greater control, especially for small or intricate workpieces.
- **CNC Routers:** Digitally controlled for mass production and precision shaping.
- **Overhead Routers**: High-powered and ideal for repetitive shaping, often seen in larger industrial shops.

Features

The Router shaping machine has a strong head that holds the cutter, mounted on vee-slide ways for smooth movement. The head drops by its own weight and is lifted using a foot pedal. The table also moves up or down using a hand wheel and screw for height adjustments. This setup helps control depth and shape accurately.

Specific Uses

The router shaping machine is mainly used for fine detailing on wood, such as shaping borders, making grooves, or cutting fancy profiles. It is perfect for decorative furniture, cabinet edges, and joining parts with dovetail or rebated joints.

Operations

With the right cutter and attachments, the router shaping machine can perform:

- Square and moulded profiling
- Intricate recessed designs
- Grooving (long narrow slots)
- Rebating and cutting clean steps
- Dovetailing for joint making
- Cutting various types of decorative shapes

f. Grinding machine

Sharp tools are vital in woodworking, but they dull over time. The grinding machine restores its sharpness, ensuring safe and precise work. ***Table 1.2.4*** shows the description, features, specific uses and its operations.

Description with Diagram

A grinding machine is a special tool used mainly for sharpening cutting tools in woodworking. It helps keep blades sharp, which is important for accurate cutting and smooth finishes on wood. It also helps improve the surface finish of wood in some cases.

Features

The grinding machine has a rotating abrasive wheel that sharpens metal tools like chisels, plane blades, and drill bits. It often includes tool rests, guards for safety, and adjustable parts to hold tools at the correct angle during sharpening.

Specific Uses

The grinding machine is mainly used to sharpen dull tools to restore their cutting edge. Sharp tools make woodwork safer, faster, and cleaner.

Operations

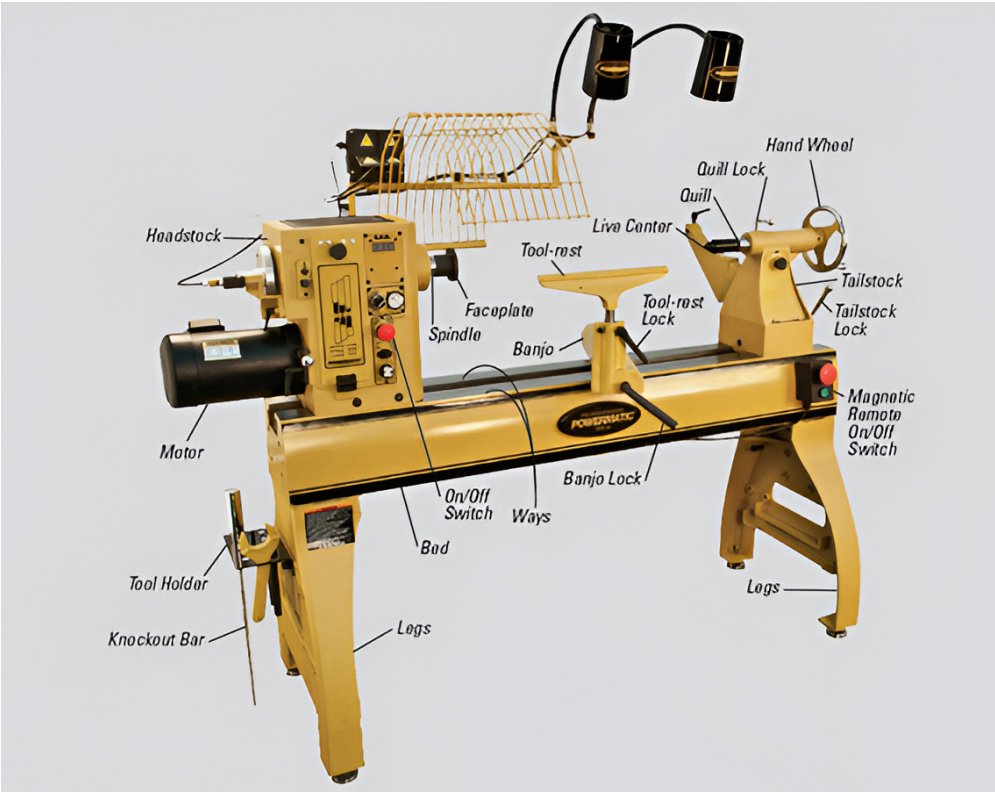
To use the grinding machine, the tool is held against the rotating wheel at a right angle. The user gently moves it back and forth until the edge is sharp. Care is taken not to overheat the metal, which can damage the tool.

g. Lathe machine

Description with Diagram

To shape curved wood pieces like chair legs or bowls, woodworkers use a lathe machine. It spins the wood while cutting tools shape it into smooth, round forms. ***Table 1.2.5*** shows the description, features and specific use, how it operates and tools used to help you craft detailed pieces with skill and precision.

The lathe machine is used to shape wood into round or circular forms. It rotates the wood while a cutting tool shapes it. This can be done along or across the grain, depending on the item being made.



Features

The lathe machine has a headstock (with the motor and spindle), a tailstock (which supports the other end of the wood), and a tool rest (to guide the cutting tool). The wood spins between the head and tailstock while the operator shapes it.

Specific Uses

The lathe machine is used to make round items like drawer handles, tool handles, table and chair legs, bowls, and trays.

Operations

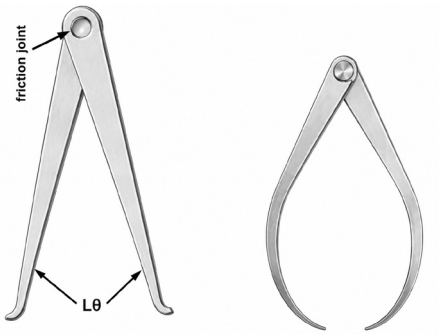
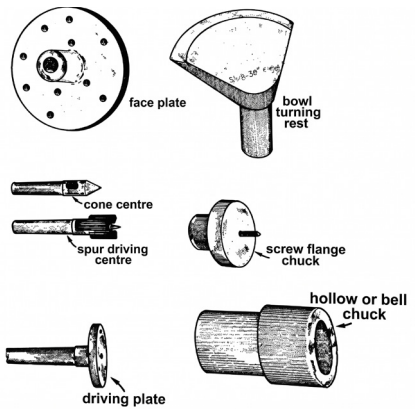
The wood is mounted between the headstock and tailstock, and as it spins, the user applies cutting tools like chisels to shape it. The user must control tool pressure and movement for accurate shaping.

Stepwise Operations of the Lathe Machine

1. Mount the wood securely between the headstock and tailstock.
2. Adjust the tool rest close to the wood without touching it.
3. Switch on the machine and allow the wood to spin smoothly.
4. Hold the chisel firmly and rest it gently on the tool rest.
5. Apply the chisel to the spinning wood with steady hands.
6. Shape the wood slowly, controlling the pressure and movement.

7. Check your progress regularly using callipers for accuracy.
8. Stop the machine when the desired shape is achieved.
9. Smooth and finish the work if needed.

Lathe Machine Accompanying Tools

Lathe Machine Accompanying Tools			
Name and Description	**Features**	**Specific uses**	**Diagram**
Chisel Edges (Used on the Lathe) Lathe chisels are sharp-edged cutting tools used for shaping the wood as it spins.	Chisel Edges have long handles for control and various cutting-edge shapes (e.g., gouge, skew, parting tool).	It is used for rough shaping, fine detailing, cutting grooves, and finishing round forms on wood.	
Inside and Outside Callipers Callipers are measuring tools used during turning to check thickness and size.	• Inside callipers measure the inner width (e.g., inside a bowl). • Outside callipers measure outer diameters (e.g., the thickness of a leg or handle).	Inside and Outside Calipers used to check and maintain correct measurements while shaping or finishing turned pieces.	
Lathe Devices These are tools used to hold the wood firmly between the headstock and tailstock during turning.	The features include faceplates, drive spurs, and cone centre, screw flange chuck, hollow or bell chuck, bowl turning rest, driving plate that grips the timber securely.	They keep the wood steady while it spins, making it safe and accurate to cut and shape.	

Drum Sander Machine

Smooth surfaces are essential for quality woodwork. The drum sander efficiently sands large areas, making wood ready for fine finishing. The text below outlines its description, features, uses, and role in fast, precise surface preparation.

Description with Diagram

The drum sander machine is used to smooth and level large wooden surfaces quickly and evenly. It works like a thicknesser but uses abrasive sanding drums instead of sharp cutters. This makes it ideal for giving wood a fine, flat finish.

Features

The drum sander machine has one to three rotating drums, each covered with sandpaper of different roughness (grades).

- The first drum uses coarse paper to remove rough, uneven areas.
- The second drum uses medium paper for smoothing.
- The third drum uses fine paper for a clean, flat finish.
- It also includes a dust collection system that removes wood dust during sanding, keeping the work area clean.

Specific Uses

The drum sander machine is used for:

- Smoothing tabletops, panels, and boards
- Levelling glued wood surfaces
- Preparing wood for finishing (painting or polishing)

Operations

- The wood is placed on the feeding belt.
- The machine pulls the wood under the rotating drums.
- Each drum sands the surface in stages, from rough to fine.
- The dust system sucks away sanding particles.
- The result is a clean, flat, and smooth wood surface.

Safety Precautions When Using Woodworking Machines

It is extremely important to follow safety precautions when using woodworking machines. These machines are powerful and can cause serious injuries if used incorrectly. Sharp blades, fast-moving parts, and heavy materials create potential hazards such as cuts, amputations, or eye injuries. By wearing protective equipment, keeping machines well-maintained, and following proper operating procedures, you can reduce the risk of accidents and create a safer working environment. Good safety practices also help maintain focus, protect equipment, and ensure high-quality workmanship.

Safety Precautions

a. Tie back long hair to prevent it from getting caught in the rotating parts.

b. Avoid loose clothing: wear fitted attire to stay safe around moving parts.

c. Remove all jewellery (e.g., rings, watches, any dangling jewellery) and ID tags before using the machine. These can snag and cause injury.

d. Avoid loose clothing. Wear a fitted workshop coat or apron.

e. Always wear appropriate PPE

- Safety goggles or face shields
- Dust masks or respirators (especially if working with hardwood or MDF)
- Hearing protection if noise levels are high.

f. Keep hands off spinning workpieces: Use tools, not fingers!

g. Before using a machine, ensure guards and shields are in place.

h. Secure the workpiece firmly before operating the machine.

i. Follow the machine's risk assessment and standard operating procedures at all times.

j. Stay focused, no distractions while the machine is running.

Activity 1.2.1 Using Woodwork Machines Effectively

Scenario: You are a member of a junior carpentry startup team. Your team has received an order to produce parts of a wooden reading desk. Your challenge is to decide which woodwork machines to use for specific operations like smoothing, shaping, and joining. You must explain your choices, apply safety measures, and demonstrate your understanding through sketches and peer teaching.

Materials Needed

- Short video clips or slide presentations showing real machines in use
- Wood samples (softwood and hardwood)
- Printed worksheets with tables and guiding questions
- Posters or printed pictures of machines
- Large sheets of paper, coloured markers, glue, scissors
- Laptop/projector/smartphone (optional)
- Safety gear (goggles, gloves, apron, earplugs)
- Access to a simulated machine (a computer-based version of a real machine used for safe practice and training) or a real machine if safely available.

Activity Guidelines

1. Organise yourself into a group of 3-5 members.
2. Watch pictures/a video/slide presentation showing the following machines:
   - **a.** Mortising machine
   - **b.** Router shaping machine
   - **c.** Spindle moulder
   - **d.** Grinding machine
   - **e.** Lathe machine
   - **f.** Drum sander
3. Take notes on
   - **a.** Name of each machine
   - **b.** Its use (e.g., shaping, cutting, drilling, etc.)
   - **c.** One safety rule when using it
4. Complete the Machine Task Table on your worksheet:

Machine Name	Use	Safety Rule	Task It Is Good For

5. You and your group members should select one carpentry part (e.g., desk leg, drawer, top surface).
6. Choose one or more suitable machines for creating the part.
7. On a poster or large paper
   - **a.** Draw a simple sketch of your carpentry part
   - **b.** Label the part and machines used
   - **c.** Explain why each machine was chosen
   - **d.** Highlight the task (e.g., smoothing surface, cutting joint)
   - **e.** Mention one safety rule to follow
8. Take turns (under supervision) using a machine (real or simulated) to complete your selected task.
   - **a.** Wear full safety gear
   - **b.** Record or note down what you did
   - **c.** Reflect: Was your machine choice right? Why or why not?
9. Present your poster/sketch to the class
10. Explain
    - **a.** Machine selection
    - **b.** Task done
    - **c.** Safety rules applied
11. Answer peer questions and accept suggestions.
12. Write answers to the questions below.
    - **a.** What did I learn about selecting machines?
    - **b.** Which safety rule is most important to me and why?
    - **c.** How could using the wrong machine affect the quality of the work?
    - **d.** Which three machines do I now understand well, and what are they best used for?

Conclusion

By learning to select the right machine for each woodwork task, you build confidence and independence in the workshop. Knowing which machine to use, whether for

cutting, shaping, drilling, or smoothing, helps you to work safely, save time, and produce quality results. This skill prepares you for real-world projects and future careers in carpentry and joinery.

EXTENDED READING

- Jackson, A. & Day, D. (1997). Woodworker's manual. London: Harper Collins Publishers. Pages 190-208.
- Walton, J. (1970). Woodwork in Theory and Practice (metric edition). Pages 293-309.

REVIEW QUESTIONS

1. You have been asked to make a wooden table with straight edges and a smooth surface. Choose the most appropriate machine for each step below:
   a. Cutting the wood to sizes
   b. Making the joints
   c. Smoothing the surface
2. Explain why each of the following machines is the best choice for its task when making a wooden table.
   a. Why is the ***Router shaping machine*** good for shaping/moulding the wood?
   b. Why is the ***Mortising/Drilling machine*** suitable for making joints?
   c. Why is the Drum sander machine ideal for smoothing the surface?
3. What should you consider before choosing a machine for a task?
4. Why is it important to select the right machine for each woodwork operation?
5. How does knowing different machines improve your skills in the workshop?

UNIT 3

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

In any building, several essential services work together to create a safe and comfortable environment. Among these, electricity supply, cold water installation, and waste disposal play key roles. Although they all support daily living, each system serves a different purpose and operates in its own way. Electricity supply provides power for lighting, appliances, and equipment, making modern life possible. Cold water installation delivers clean water for drinking, cooking, and washing, ensuring health and hygiene. Waste disposal, on the other hand, removes used water and waste materials from the building, keeping the space clean and safe. Understanding the differences between these systems helps us appreciate how buildings function and how each service contributes to our well-being. By learning to distinguish between them, we gain a clearer view of how essential building services are designed and maintained.

The study of excavation in year two is very important for your understanding of this year 3 lesson. Excavation is very important for this study as the three services are provided through excavation.

KEY IDEAS

- Cold water installation delivers clean water for drinking, washing, and other daily uses.
- Each system has its own network of pipes, cables, or fixtures designed for a specific purpose.
- Electricity supply provides power to buildings for lighting, appliances, and equipment.
- Waste disposal removes used water and solid waste safely from the building.
- While electricity powers devices, water systems support hygiene, and waste systems protect health and the environment.

EXPLANATION OF DIFFERENT SERVICES SUPPLIED TO CONSUMERS IN BUILDINGS

Buildings provide key services that support safe and comfortable living. Water supply delivers clean water for drinking, cooking, cleaning, and sanitation. Electricity powers

lights, appliances, and systems like heating and cooling. Gas supply, often used for cooking and heating, is delivered through pipelines or cylinders.

Ventilation and air conditioning systems help maintain fresh air and comfortable temperatures indoors. Waste disposal handles both solid waste and sewage—garbage is collected regularly, while wastewater flows through drainage pipes to treatment facilities.

Communication services such as the internet, telephone, and TV are provided via cables or wireless networks, keeping residents connected. Security systems like locks, alarms, and cameras protect people and property.

These services work together to make buildings functional and liveable. Proper planning and maintenance ensure they operate efficiently and safely, contributing to the well-being of everyone who uses the building.

Table 1.3.1: *The different services supplied to consumers in buildings*

DIFFERENT SERVICES	DESCRIPTION
Electricity	Electricity in a building powers everything from lights and appliances to heating and cooling systems. • **Source:** Comes from the national grid or solar panels. • **Distribution:** Flows through wires hidden in walls and ceilings. • **Safety:** Protected by circuit breakers and fuses to prevent overloads or fires. • **Control:** Switches, sockets, and control panels let you manage power use.
Cold Water Installation	This system brings clean water into the building for drinking, washing, and cooking. • **Source:** Supplied by a local water company or a private well. • **Pipes:** Water travels through pipes made of copper or plastic. • **Storage:** Sometimes stored in tanks before use. • **Fixtures:** Delivered to taps, toilets, and appliances like washing machines.
Waste Disposal	• Waste disposal removes used water and garbage from the building safely. • **Drainage System:** Pipes carry wastewater from sinks, toilets, and showers to the sewer. • **Solid Waste:** Trash is collected in bins and taken away by waste management services. • **Ventilation:** Pipes are vented to prevent bad smells and allow smooth flow. • **Treatment:** Wastewater is cleaned at treatment plants before being released back into nature.

Maintenance and Repairs	1. **Plumbing:** Repairing and maintaining water and drainage systems. 2. **Electrical:** Ensuring the proper functioning of electrical systems. 3. **HVAC:** Maintaining and repairing heating, ventilation, and air conditioning systems. 4. **Roofing:** Repairing or replacing damaged roofs. 5. **Painting:** Maintaining the aesthetic appeal of the building's interior and exterior. 6. **Landscaping:** Maintaining and enhancing the outdoor spaces of a property.
Other Important Services:	1. **Sustainable Design:** Incorporating eco-friendly and energy-efficient practices. 2. **Design and Roof finishes:** Designing and installing the building. roofs. 3. **Security Systems:** Installing alarm systems and other security measures. 4. **Building Management Systems:** Integrating and controlling various building systems.

These services are typically offered by a variety of construction professionals, including general contractors, specialised subcontractors (plumbers, electricians, etc.), and design professionals.

Figure 1.3.1 shows clear examples of electrical supply systems. ***Figure 1.3.2*** shows a typical water connection from the main pipe to a distribution tap.

Figure 1.3.1: Typical examples of electricity supply systems.

Figure 1.3.2: Example of connection to main, stop-cock/valve on rising main.

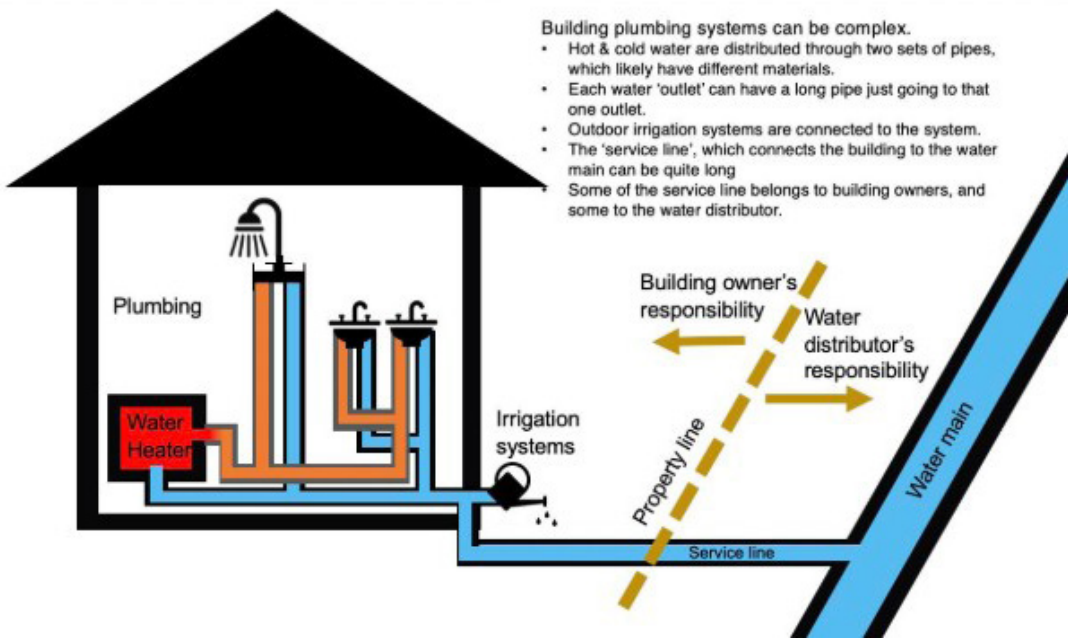


Figure 1.3.3: A typical water supply system from the main line to the distribution tap

Figure 1.3.4: Example of waste disposal at construction site

Figure 1.3.5: Example of waste disposal by a vacuum tanker or Sewerage tanker

DIFFERENT AUTHORITIES INVOLVED IN THE SUPPLY OF SERVICES

In building construction, a variety of authorities and stakeholders play crucial roles in the supply of services, ensuring projects are completed safely, efficiently, and according to regulations. These include governmental bodies, regulatory agencies, professional organisations, and private sector entities. ***Table 1.3.2*** provides a detailed description of the different authorities involved in supplying services.

Table 1.3.2: *Different authorities involved in supplying building services*

AUTHORITIES	DESCRIPTION
1. Water Company	• Provides clean water to buildings. • Maintains water pipes and meters.
2. Electricity Provider	• Supplies electrical power. • Installs and manages power lines and meters.
3. Gas Company	• Delivers gas for cooking and heating. • Ensures safe installation and supply.
4. Local Government or Municipality	• Manages waste collection and sewage systems. • Oversees building permits and safety regulations.
5. Telecommunication Companies	• Provide internet, phone, and TV services. • Install cables and network equipment.
6. Fire and Safety Department	• Checks fire safety systems like alarms and extinguishers. • Approves emergency exits and safety plans.
7. Environmental Agencies	• Monitor pollution and waste disposal. • Ensure services follow environmental rules.

8. Building Control Authority	• Inspects construction and service installations. • Makes sure buildings meet legal standards.

Differentiation of Systems, Means, Gadgets and Mixtures By Different Companies for Different Services

In building construction, companies differentiate themselves based on the systems, means, gadgets, and fixtures they use to deliver services such as design, planning, execution, quality control, safety, and sustainability. This differentiation helps construction firms enhance efficiency, safety, cost-effectiveness, and innovation as shown in ***Table 1.3.3***.

Table 1.3.3: *Differentiation of Systems, Means, Gadgets and Mixtures by Different Companies for Different Services*

Type of Company	Systems, Means, Gadgets and Mixtures
Water companies	• Use pipe networks, water meters, pumps, and treatment chemicals to deliver clean water.
Electricity providers	• Use power lines, transformers, meters, and safety switches to supply electricity.
Gas companies	• Use pipelines, pressure regulators, gas meters, and safety valves to deliver gas.
Telecommunication companies	• Use cables, routers, satellites, and signal boosters to provide internet, phone, and TV services.
Waste management services	• Use garbage trucks, bins, recycling machines, and disposal sites to handle waste.
Air conditioning companies	• Use ducts, fans, filters, and refrigerants to control air flow and temperature.
Security companies	• Use cameras, alarms, sensors, and control panels to protect buildings.

Activity 1.3.1 Exploring Essential Building Services: Electricity, Water, and Waste Management

Scenario: You are part of a construction design team working on a new community health centre. Your task is to plan how the building will receive electricity, clean water, and waste disposal services. To succeed, you and your group must explain the role of each service, identify the authorities that provide them, and compare the systems, gadgets, and fixtures used for supply and installation.

Materials Needed

- Chart paper and markers
- Sticky notes for brainstorming
- Printed images of electric meters, water taps, septic tanks, and waste bins
- Short video clips or brochures from ECG, Ghana Water Company, Zoomlion, and Local Assemblies
- Textbooks, pamphlets, or online resources

Activity Guidelines

1. Organise yourself into a group of 4-6 members.
2. Within your group, assign one service (electricity, water, or waste) to each member so everyone has a unique role.
3. As a group, discuss:
   a. The purpose and importance of electricity, water, and waste disposal in buildings.
   b. How each service is delivered (using videos, brochures, or images).
4. Each group member writes one key function of their assigned service on a sticky note and shares it with the group.
5. Identify the main authorities responsible for each service (ECG, GWCL, Zoomlion, Local Assemblies).
6. On chart paper
   a. Create a column for each service.
   b. Place the authority names under the correct service.
   c. List or draw the systems, gadgets, and fixtures (e.g., electric meters, taps, pipes, septic tanks, bins, trucks).
7. Each group member explains the gadgets and systems related to their assigned service to the group.
8. As a group, prepare a short (3–5 minute) presentation using diagrams or flowcharts.
9. During the presentation, each member explains their part (electricity, water, or waste) so the class can understand the differences.
10. While watching other groups' presentations, write down one question or suggestion as peer feedback.
11. Reflect and write
    a. One new insight you gained about the differences between electricity supply, cold water installation, and waste disposal.

b. Why is understanding these services important for safe and sustainable building design?

12. Investigate how ECG, Ghana Water Company, and Zoomlion deliver their services to homes in your community.

13. Create a short note or sketch showing one real-world example of systems, gadgets, or authorities in action.

Conclusion

Electricity supply, cold water installation, and waste disposal are three different but essential services in buildings. Electricity provides power, cold water installation ensures clean water for daily use, and waste disposal keeps the environment safe and healthy. Understanding their differences helps us use them wisely, know the right authorities responsible, and maintain a safe and comfortable living space.

EXTENDED READING

- Chudley, R., & Greeno, R. (1998). Building Construction Handbook (Third Edition). A division of Reed Educational and Professional Publishing Ltd. Woburn, MA 01801-2041 Pages 340–350; 350–360; 360–370.
- Hall, F., & Greeno, R. (2007). Building Services Handbook (Fourth Edition). Butterworth-Heineman Elsevier Ltd. Oxford, U.K. Pages 145–160; 165–180; 215–230.
- Mike Jones et al. (2022). Building Services Engineering For Construction, Hodder Education, C. O. U.K. Pages 60–105.

REVIEW QUESTIONS

1. A new three-bedroom self-contained house has been constructed in an area with unreliable municipal services. Propose one strategy that addresses potential failure points for each of the following: Electricity, water and wastewater disposal.
2. The local electricity authority is implementing smart grid technology, while the water authority is upgrading to automated meter reading. Evaluate how these technological changes will influence the provision of building services.

UNIT 4

WOODWORK TECHNOLOGY

TOOLS AND MACHINES IN THE WOODWORK INDUSTRY

Introduction

In this unit, you will learn how to select and use the right woodworking machine for each specific task on your own. You will explore different types of machines, understand what they are used for, and practise how to apply them safely and correctly. This skill is important because it helps you work faster, produce better results, and stay safe in the workshop. By the end of the unit, you will be able to confidently choose the most suitable machine for any operation, making you more skilled and independent in your woodwork projects.

In Year 2, you learned how to select and use the right machine for specific woodwork tasks with guidance. In this unit, you are building on that knowledge by learning to choose the appropriate machine on your own. This means working more independently, using your understanding of each machine's function to make the best choice for cutting, shaping, drilling, or smoothing wood.

KEY IDEAS

- Always check the purpose of the machine before using it.
- Be sure the machine matches the operation you want to perform.
- Choose the right tool or attachment for each specific machine.
- Decide based on the type of wood and the work needed.
- Ensure all safety checks are done before starting the machine.
- Follow the correct steps to operate the selected machine confidently.

USE AN APPROPRIATE MACHINE FOR A SPECIFIC OPERATION (CNC)

A CNC (Computer Numerical Control) machine is a special woodworking tool that uses a computer to control how wood is cut, carved, or shaped. Instead of using your hands to guide the tool, the computer follows a set of programmed instructions to do the job with high precision and accuracy.

CNC machines are ideal for tasks that require detailed patterns, repeated shapes, and smooth finishes. They are used to make items like carved panels, signs, furniture parts, and complex designs that would take a lot of time and skill to do by hand. These machines help woodworkers work faster, more accurately, and with less waste. Once the design is entered into the computer, the machine takes over and does the rest. This makes the CNC machine a powerful and efficient choice for modern woodwork operations.

In this unit, you will learn how the CNC machine works, when to use it, and how to follow basic safety and setup steps to complete a specific task successfully.

Mortising/Drilling Machine (CNC)

Woodworking today demands precision and speed. CNC mortising/drilling machines use computer control to make exact cuts and holes. The CNC mortising/drilling machine is a computer-controlled woodworking tool used to cut accurate mortises, holes, and complex joinery patterns. It replaces manual effort with automated precision, making it perfect for modern furniture and cabinet making. ***Table 1.4.1*** shows the features, specific uses and how to operate it.

Table 1.4.1: *Features, specific uses and how to operate*

Name and Diagram	Features
Mortising/Drilling machine (CNC) 	This Mortising/ **A drilling machine (CNC)** works using CAD/CAM software, which allows the user to design the shape or pattern on a computer. The design is then sent to the machine, which automatically drills or cuts according to the instructions. It has a strong frame, high-speed drill bits, and a digital control panel.
Specific Uses	**Operations**
The CNC mortising/drilling machine is used to: • **Cut precise mortises** for strong joints • Drill **exact holes** for fittings and assembly • Carve **complex patterns** in wood panels • Speed up production in **furniture and cabinet workshops**	**1.** The user creates a design using CAD software. **2.** The program is loaded into the CNC machine using CAM software. **3.** The wood is fixed on the machine bed. **4.** The machine follows the design and begins drilling or cutting. **5.** The process is completed with high accuracy, without manual cutting.

Router Shaping Machine (CNC)

Modern woodworking needs clean designs and precise cuts. The CNC router shaping machine is a computer-controlled tool that makes this possible by accurately cutting, carving, engraving, shaping joints, and even doing 3D sculpting. It works not only on wood but also on soft materials like plastics and soft metals. This smart machine automates complex tasks, making it very useful in furniture making, cabinetry, sign-making, and custom woodwork - allowing users to create smooth and detailed pieces with speed and ease. ***Table 1.4.2*** shows the Router shaping machine (CNC) with its features, specific uses and operations.

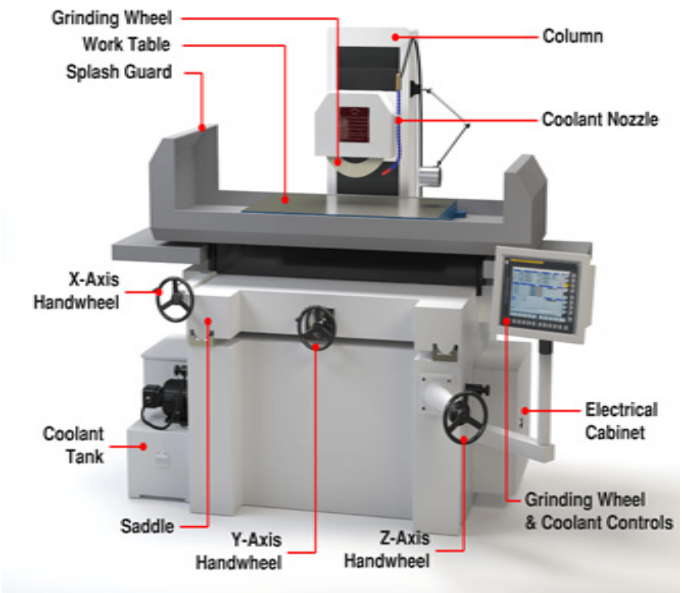
Table 1.4.2: *Router shaping machine (CNC) with its features, specific uses and operations*

Name and Diagram	Features
Router shaping machine (CNC) Potable CNC router machine	The **Router shaping machine (CNC)** uses CAD software to design shapes and CAM software to convert the design into machine instructions. It has a fast-spinning cutting head (router) mounted on a movable frame. The cutting tool moves in different directions (up, down, left, right, forward, and back) with great accuracy. Some models are portable and can be mounted on a table.
Specific Uses	**Operations**
The CNC router shaping machine is used for: • Cutting out furniture parts and panels • Engraving and carving decorative patterns • Creating 3D designs and logos • Making accurate joints for furniture assembly • Producing signs and detailed artwork	**1.** Design the work using CAD software. **2.** Convert the design to machine instructions using CAM software. **3.** Fix the wood or material onto the machine bed. **4.** Start the machine to automatically cut, shape, or engrave based on the design. **5.** The finished piece is produced with high accuracy and a smooth finish, ready for use or assembly.

Grinding Machine (CNC)

In woodworking, sharp tools and smooth finishes are key to producing quality work. The CNC grinding machine is a computer-controlled tool that helps achieve this by accurately sharpening, shaping, and polishing tools like blades, chisels, and drill bits. It can also smooth wooden edges and surfaces to a fine finish. This machine saves time, improves results, and keeps tools in excellent condition for repeated and precise use, making it essential for high-quality woodworking. ***Table 1.4.3*** shows the Grinding machine (CNC) with its features, specific uses and operations.

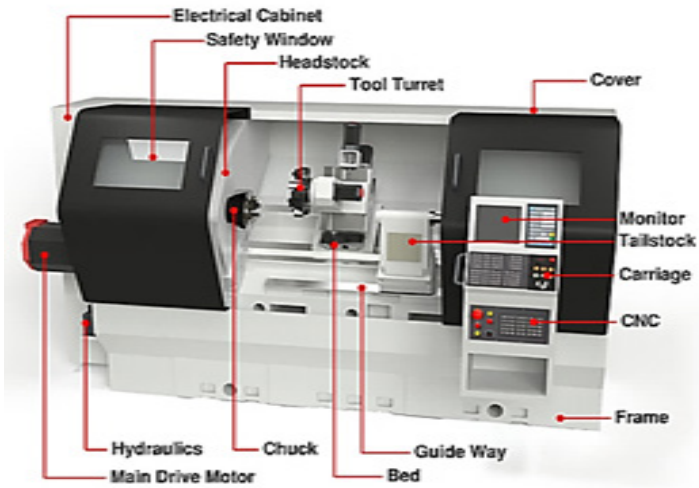
Table 1.4.3: *Grinding machine (CNC) with its features, specific uses and operations*

Name and Diagram	Features
Grinding machine (CNC)  	**Grinding machine (CNC)** uses CAD/CAM software to control grinding actions with high accuracy. It has a rotating grinding wheel, a tool-holding system, and sensors for precise shaping. The machine automatically adjusts angles and pressure, reducing human error and improving consistency.
Specific Uses	**Operations**
Grinding machine (CNC) is used to: **1.** Sharpening dull woodworking tools like saw blades and chisels **2.** Shaping cutting tools to specific angles **3.** Smoothing and polishing wooden surfaces and edges. **4.** Maintaining tool quality in professional woodworking shops.	**1.** Is designed using CAD software. **2.** The tool or wood piece is fixed in place on the machine. **3.** The machine reads the design and begins grinding automatically. **4.** The grinding wheel rotates to sharpen or polish the surface accurately. **5.** Once complete, the tool or wood edge is smooth, sharp, and ready for use.

Lathe Machine (CNC)

Hand-turning wood takes time and skill, especially for fine details. The CNC lathe machine makes this work faster and more accurate by using computer control to automatically shape wood. It is a computer-controlled tool that rotates wood against cutting tools, replacing manual turning with automated precision. This allows woodworkers to easily create smooth, detailed, and complex designs in a shorter time and with consistent results. ***Table 1.4.4*** shows the features, specific uses and how to operate.

Table 1.4.4: *Lathe machine (CNC) with its features, specific uses and operations*

Name and Diagram	Features
Lathe machine (CNC)  	The Lathe machine (CNC) uses CAD software to design shapes and CAM software to convert the designs into cutting instructions. It has a rotating spindle to hold the wood, and fixed cutting tools that shape the spinning piece. The machine ensures uniform cutting, smooth curves, and detailed profiles without manual effort.
Specific Uses	**Operations**
The Lathe machine (CNC) is used: • To make spindles, table legs, chair legs, and bowls • To craft decorative columns and curved parts for furniture • To Produce repeated shapes with the same size and detail • In furniture making and wood art workshops	**1.** A design is made using CAD software. **2.** The design is sent to the machine through CAM software. **3.** The wood is mounted on the machine's spindle. **4.** The machine rotates the wood while the cutting tool shapes it. **5.** The machine follows the programmed path to produce precise, smooth, and identical results.

Drum Sander Machine (CNC)

Smooth surfaces are important in making quality furniture and wood products. The CNC drum sander machine is a computer-controlled tool that helps achieve this by automatically sanding wood surfaces with high accuracy. Unlike manual sanding, it ensures even, consistent, and clean finishes with less effort. This makes it a time-saving and reliable machine widely used in modern woodworking.

Table 1.4.5: *Drum sander machine (CNC) with its features, specific uses, and operations*

Name and Diagram	Features
Drum sander machine (CNC) 	The Drum sander machine (CNC) uses abrasive drums to sand wood evenly and is guided by computer software (CAD/CAM). The machine has a dust extraction system that removes wood dust during sanding, keeping the workspace clean. It ensures the same pressure and motion throughout the process for a smooth and professional finish.
Specific Uses	**Operations**
The Drum sander machine (CNC) is used: • To smoothen furniture panels and surfaces • To prepare wood for painting, polishing, or joining • In furniture production, cabinetry, and custom woodwork • To reduce human errors and ensure uniform surface quality	**1.** The sanding path is created using CAD software and sent to the machine. **2.** The wooden board is placed on the machine's conveyor belt. **3.** The machine pulls the wood through rotating abrasive drums. **4.** As the wood moves, it is sanded evenly on all sides. **5.** Dust and particles are removed through the dust extraction system. **6.** The result is a smooth, clean, and ready-to-finish wooden surface.

Safety Precautions When Using CNC Woodworking Machines

Although CNC machines are computer-operated, it is still extremely important to follow safety precautions when using these machines. By wearing protective equipment, keeping machines well-maintained, and following proper operating procedures, you can reduce the risk of accidents and create a safer working environment. Good safety practices also help maintain focus, protect equipment, and ensure high-quality workmanship.

Safety Precautions

1. Tie back long hair to prevent it from getting caught in the rotating parts.
2. Avoid loose clothing: wear fitted attire to stay safe around moving parts.
3. Remove all jewellery (e.g., rings, watches, any dangling jewellery) and ID tags before using the machine. These can snag and cause injury.
4. Avoid loose clothing. Wear a fitted workshop coat or apron.
5. Always wear appropriate PPE
   a. Safety goggles or face shields
   b. Dust masks or respirators (especially if working with hardwood or MDF)
   c. Hearing protection if noise levels are high.
6. Keep hands off spinning workpieces: Use tools, not fingers!
7. Before using a machine ensure guards and shields are in place.
8. Secure the workpiece firmly before operating the machine.
9. Follow the machine's risk assessment and standard operating procedures at all times.
10. Stay focused, no distractions while the machine is running.

Activity 1.4.1 Exploring CNC Machines in Woodwork

Scenario: You are part of a learner design team at a Koffy furniture startup. The company just received a big order for custom-designed furniture. Your team must choose the right CNC machines to create the parts, design a sample product using CNC processes, and show how it benefits both business and the environment.

Materials Needed

- Short video or slideshow on CNC machines

- Posters/photos of CNC machines in action
- Sample wood types (MDF, plywood, hardwood)
- Worksheets with guiding questions
- Drawing/sketching tools or design apps
- Large paper sheets and markers
- Projector/laptop/tablets
- Teacher observation checklist
- Safety gear: gloves, goggles, aprons

Activity Guidelines

1. Organise yourself into a group of 3-5 members.
2. Watch a short video or slideshow on CNC wood machines.
3. List 3 CNC machines shown and describe their main function.
4. Use printed resources or internet tools to find;
   a. How each machine works
   b. What types of wood is it best for?
   c. One safety rule for each machine
5. Complete a Table (Worksheet)

CNC Machine	Function	Material	Example Task	Safety Tip
CNC Router	Carves designs	MDF	Chair backrest	Wear goggles

6. Create a Product
   a. Design a small furniture part (e.g., chair leg, tabletop, cabinet door).
   b. Choose one CNC machine for each process (cutting, shaping, engraving, etc.).
   c. Show what type of wood you would use and why.
7. Make a Poster or Simple Mock-up (on paper or digitally) include;

   a. Product name
   b. Materials used
   c. Machines used (with short reasons)
   d. Who would use the product?
   e. Economic benefits and
   f. Environmental benefits
8. Present your poster/mock-up to the class.
9. Explain your machine choices and how they improve quality and save time.
10. Listen to peer feedback and respond to their questions.
11. Write a short paragraph answering:
   a. What CNC machine was new or surprising to me?
   b. What task would you use it for in real life?
   c. How can you promote safe use of CNC machines?

Conclusion

Knowing how to select the right machine for each woodwork task helps you work safely, faster, and with better results. By understanding the purpose and use of each CNC machine, you can confidently choose and operate the one that best fits the job. This skill prepares you for real workshop situations and makes you a more effective and independent woodworker.

EXTENDED READING

- Nur Aqila B. K. Zamal & Hamdi B. H. Mawardi (2024) 3 Axis CNC Router (Operation & Components. Published by Unit Penerbitan. Pages 5-9; 18-21; 36-42.
- https://web.iitd.ac.in/~jay/dsl732/dsl732_2019/topics/computer_controlled_machining/cnc_router_big_user_manual.pdf

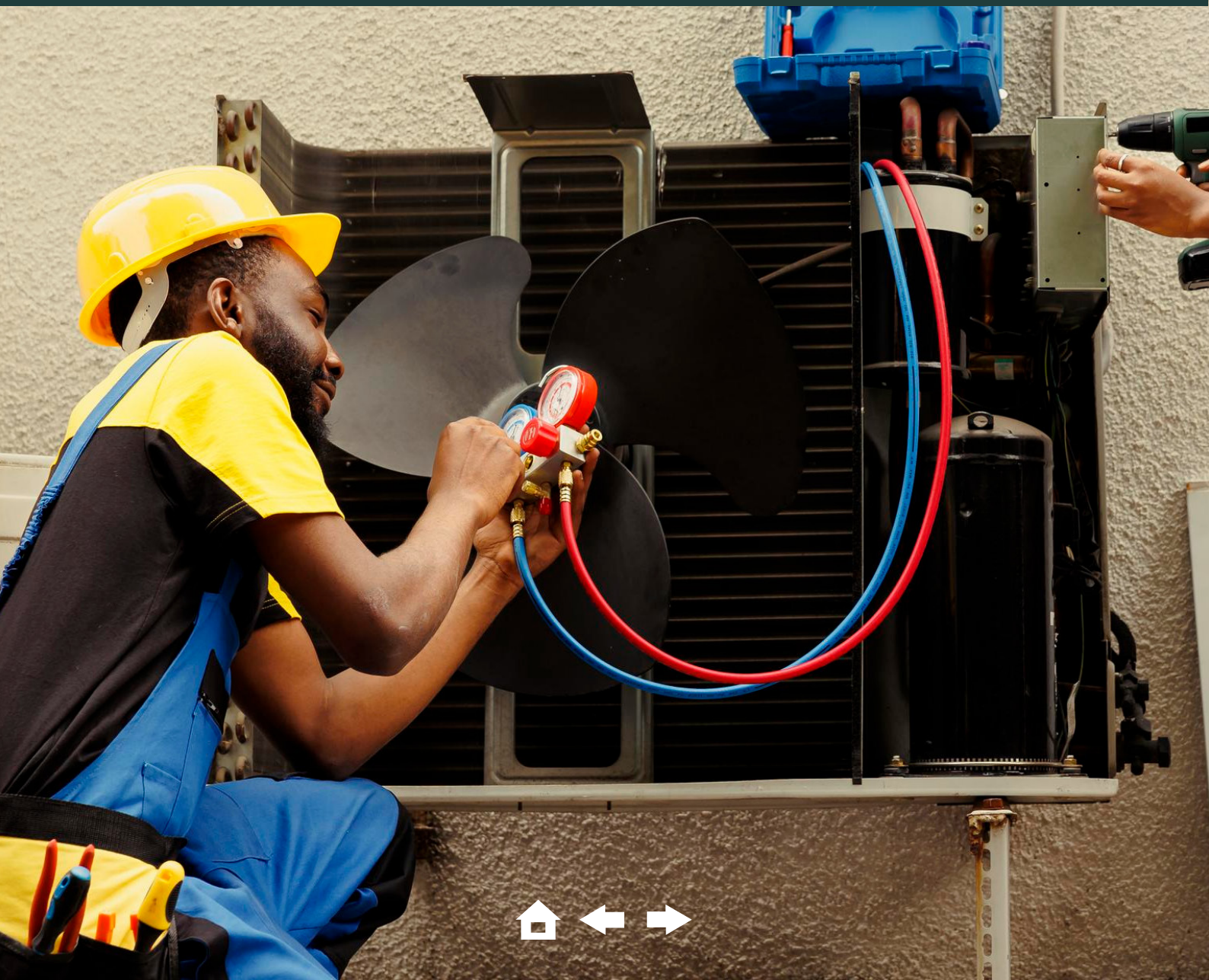
REVIEW QUESTIONS

1. You are a woodwork learner assigned to make a dining chair with the following parts
   a. A curved backrest
   b. Mortise and tenon joints
   c. Turned legs
2. Which machines will you use to produce each of these parts, and how will you use them?
3. Why is each machine appropriate for its task?
4. How do you know which machine to use for a specific woodwork task?
5. Why is it important to choose the right machine for each operation?
6. What should you do before using any machine in the workshop?

SECTION

2

ELECTRICITY, WATER SUPPLY AND MAINTENANCE OF MACHINES AS WELL AS LKS, LUS, NTFPs)



UNIT 5

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

Installing electricity in a building follows a planned schedule of works to ensure safety, efficiency, and proper operation. This schedule outlines the step-by-step process that electricians and contractors follow from the beginning to the end of the project. It usually starts with designing the electrical layout, which includes deciding where sockets, switches, and lighting will be placed. Next comes preparing the site, followed by installing cables, conduits, and distribution boards. After that, electrical fixtures and fittings are connected, and the system is tested to make sure everything works correctly and meets safety standards. Finally, the installation is inspected and approved before the building is ready for use. Following a clear schedule helps avoid mistakes, saves time, and ensures the electrical system is reliable. Understanding this process is important for anyone involved in construction, renovation, or building maintenance.

In Year 1, you studied the roles of professionals in electricity. This study about work schedules in the field of electricity will help you understand that having a proper schedule allows professionals to work more efficiently and effectively.

KEY IDEAS

- The work begins with planning and designing the electrical layout of the building.
- Electricians prepare the site and install cables, conduits, and distribution boards.
- Fixtures like switches, sockets, and lights are then connected to the system.
- The entire electrical setup is tested to ensure it works safely and correctly.
- A final inspection is done before the system is approved for use.

WHAT IS ELECTRICAL INSTALLATION?

Electrical installation refers to the process of designing, setting up, and maintaining electrical systems within a building or structure, ensuring a safe and efficient power supply. This includes installing wiring, outlets, lighting fixtures, and other electrical equipment. Proper electrical installation is crucial for safety, functionality, and energy

efficiency. ***Table 2.5.1 shows a more detailed description of what an electrical installation is.***

Table 2.5.1: *Electrical installation*

ELECTRICAL INSTALLATION	DESCRIPTION
Key aspects of electrical installation	1. **Planning and Design:** Creating a detailed plan that includes the placement of all electrical components. 2. **Material Selection:** Choosing high-quality electrical cables, sockets, switches, and other components. 3. **Installation:** The physical process of installing wiring, conduits, and electrical devices. 4. **Testing and Commissioning:** Ensuring the installation is safe and functioning correctly. 5. **Compliance with Regulations:** Adhering to safety standards and regulations during the entire process.
Importance of proper electrical installation	1. **Safety:** Prevents electrical hazards like shocks and fires. 2. **Functionality:** Ensures all electrical devices and appliances work as intended. 3. **Energy Efficiency:** Optimises energy consumption and reduces costs. 4. **Legal Compliance:** Meeting legal obligations and avoiding potential legal issues.
Who is involved in electrical installation?	1. **Electricians:** Install and maintain electrical systems. 2. **Electrical Engineers:** Design and oversee electrical systems.
Examples of electrical installations	1. **Residential:** Wiring a new house, installing lighting fixtures, and setting up electrical outlets. 2. **Commercial:** Installing power distribution systems, lighting, and specialised equipment in offices, stores, and other commercial buildings. 3. **Industrial:** Designing and implementing complex electrical systems for factories and other industrial facilities.

The Major Schedule of Works Involved In Electrical Installation

The major schedule of works involved in electrical installation typically includes planning, rough-in, finish work, and final testing. This involves tasks like site preparation, conduit and wiring installation, fixture installation, and thorough testing of all components. ***Table 2.5.2 gives details of the major schedules of work involved in electrical installation.***

Table 2.5.2: *Schedule of electrical installation*

MAJOR SCHEDULE IN ELECTRICAL INSTALLATION	DESCRIPTION
Planning and Preparation	1. **Review and finalise the electrical plan:** This includes ensuring the plan aligns with the architectural design and building codes. 2. **Gather necessary materials and tools:** This includes cables, conduits, switches, outlets, and testing equipment. 3. **Prepare the site:** This may involve marking locations for outlets, switches, and fixtures, and ensuring a safe working environment.
Rough-in	1. **Install conduit and raceways:** This involves running pipes or channels to protect and route electrical wiring. 2. **Install wiring:** This includes pulling cables through the conduit and making connections to junction boxes. 3. **Install electrical boxes:** These house switches, outlets, and other electrical components.
Finish Work	1. **Install switches, outlets, and fixtures:** This involves connecting the wiring to these devices and ensuring they are properly secured. 2. **Install the main electrical panel (or consumer unit):** This is the central distribution point for electricity in the building. 3. **Install grounding and bonding:** Ensuring proper grounding is crucial for safety.

Testing and Commissioning	1. **Conduct continuity and polarity tests:** Checking for proper connections and ensuring wires are correctly installed. 2. **Perform voltage and grounding tests:** Verifying that the electrical system is functioning as designed and that safety measures are in place. 3. **Test all circuits and fixtures:** Ensuring lights, outlets, and other electrical components are working correctly. 4. **Final walkthrough and inspection:** A final check to ensure everything is installed correctly and safely before powering up.

THE DIFFERENT STAGES OF ELECTRICAL INSTALLATION

Electrical installation, whether in a new build or renovation, generally progresses through several key stages: planning and design, rough-in, trim-out, and final inspection and commissioning. Each stage is crucial for ensuring a safe, efficient, and code-compliant electrical system. ***Figures 2.5.1 and 2.5.2*** show the different stages involved in electrical installation and examples of different colours of cables used for electrical installation.

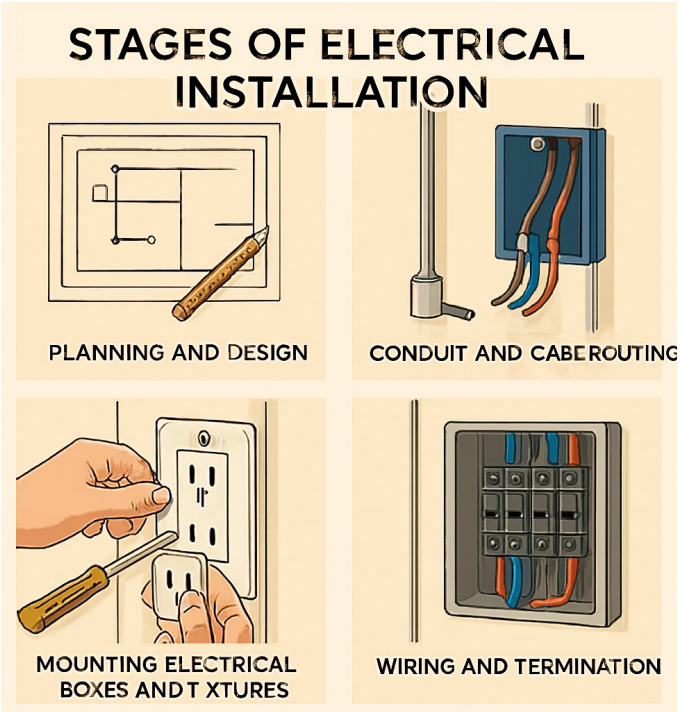


Figure 2.5.1: The different stages of electrical installation

WIRE	COLOR	TERMINAL	FUNCTION
	White	W	Connect to air handler or furnace
	Yellow	Y	Connect to compressor & control your air conditioning system
	Green	G	Connects to the fan of your furnace or air handler
	Orange	O	Connects to your heat pump
	Red	Rc	24V POWER - Cooling
		Rh	24V POWER - Heating
	Blue	C	Common 24V - AC for any smart thermostat

Figure 2.5.2: Examples of different colours of cables used for electrical installation

Table 2.5.3: *The different stages of electrical installation*

DIFFERENT STAGES OF ELECTRICAL INSTALLATION	DESCRIPTION
Planning and Design	1. **Needs Assessment:** Identifying the electrical needs of the space, including the type and quantity of outlets, lighting fixtures, appliances, and any special electrical requirements (e.g., home entertainment systems, smart home technology). 2. **Layout and Schematic:** Creating a detailed electrical plan that maps out the location of all electrical components, circuits, and wiring pathways. 3. **Code Compliance:** Ensuring the design adheres to local electrical codes and regulations. 4. **Material Selection:** Choosing appropriate wiring, conduits, outlets, switches, and other electrical components.
Rough-in	1. **Conduit Installation:** Installing conduits (protective tubing) to house and protect electrical wiring. 2. **Wiring Installation:** Running electrical cables through the conduits, connecting them to the main electrical panel (circuit breaker box) and other electrical components. 3. **Fixture and Outlet Mounting:** Installing boxes for switches, outlets, and lighting fixtures, but not yet connecting the actual devices. 4. **Temporary Power:** Establishing temporary power for the construction site, often with a separate meter.

Trim-out	1. **Device Installation:** Installing and connecting switches, outlets, light fixtures, and other electrical devices. 2. **Panel Finishing:** Installing the main electrical panel (circuit breaker box) and connecting all circuits. 3. **HVAC Connections:** Connecting heating, ventilation, and air conditioning (HVAC) systems to the electrical system. 4. **Appliance Wiring:** Connecting appliances to their designated electrical circuits.
Final Inspection and Commissioning	1. **Testing and Verification:** Thoroughly testing all electrical circuits, devices, and connections to ensure proper functionality and safety. 2. **Code Compliance Inspection:** An electrical inspector verifies that the installation meets all applicable codes and regulations. 3. **Final Walkthrough:** A final walk-through with the homeowner to demonstrate the system and address any remaining questions or concerns. 4. **System Activation:** Commissioning the electrical system by energising the main electrical panel and testing all devices. 5. **Documentation:** Providing the homeowner with documentation, including blueprints, schematics, and user manuals.

Activity 2.5.1 Understanding the Schedule of Works in Electrical Installation

Scenario: Imagine you are part of an electrical engineering team hired to install electricity in a newly constructed school building. Your mission is to:

- Explain what electrical installation means
- Outline the major schedule of works required for the project
- Discuss the different stages of the installation process

You and your team will collaborate, research, and design a clear plan to ensure the school receives a safe, efficient, and complete electrical supply system.

Materials Needed

- Chart paper and markers
- Sticky notes for brainstorming

- Diagrams of electrical installation processes (printed or hand-drawn)
- Sample electrical fixture cards (e.g., plugs, switches, breakers, wires)
- Reference textbooks or safety manuals
- Short video clips or pamphlets from ECG or licensed electrical contractors

Activity Guidelines

1. Organise yourself into a group of 4-6 members.
2. Assign roles within your group (e.g., Leader, Recorder, Timekeeper, Presenter, Researcher).
3. Write a short definition of electrical installation in your notebook.
4. Share and discuss your definitions with your group. Agree on one group definition and write it on chart paper.
5. Discuss the major schedule of works involved in electrical installation (e.g., design, material selection, wiring, fixing, testing, inspection, handover).
6. Use sticky notes to record each idea, then arrange them in logical order on a group chart.
7. Encourage each member of your group to contribute at least one idea to the sequence.
8. Watch a short video or examine diagrams showing the stages of installation.
9. As a group, break down the stages step by step (e.g., design, roughing-in, fitting, testing, finishing).
10. Each member of your group should take responsibility for a stage and explain it to the group in their own words.
11. Create a flowchart or table that combines all of your group members' explanations.
12. Prepare a 3–5-minute group presentation using your flowchart or table.
13. During the presentation, you and your group members must speak briefly about the stages.
14. While other groups present, listen actively and write down one question or suggestion for peer feedback.
15. After the presentations, reflect and write in your notebook:
    a. One thing you now understand better about electrical installation
    b. One question you still have
16. Share your reflection with a partner before submitting it.
17. Draw a labelled diagram showing the stages of electrical installation for a small house.
18. Write one paragraph explaining the importance of safety precautions at each stage of the process.

Conclusion

The schedule of works in electricity supply is the step-by-step plan that ensures safe and reliable power delivery. It includes designing the system, selecting materials, wiring and fixing components, testing, inspection, and finally handing over for use. Each stage is important because skipping or rushing one can lead to faults, accidents, or wasted resources. By understanding this schedule, you gain a clear roadmap of how electricity moves from planning to safe usage in homes, schools, and workplaces.

EXTENDED READING

- Chudley, R., & Greeno, R. (1998). Building Construction Handbook (Third Edition). A division of Reed Educational and Professional Publishing Ltd. Woburn, MA 01801-204. Pages 28-35; 362-372.
- Hall, F., & Greeno, R. (2007). Building Services Handbook (Fourth Edition). Butterworth-Heineman Elsevier Ltd. Oxford, U.K. Pages 15-20; 22-25; 183-200.
- Mike Jones et al. (2022). Building Services Engineering for Construction, Hodder Education C. O. U.K. Pages 45-52; 112-135.

REVIEW QUESTIONS

1. A building requires electrical installation to be completed within a tight 6-week timeframe. Evaluate the three most critical factors that must be considered when scheduling.
2. A client requires the integration of smart building technologies into the electrical installation of a building. Evaluate how any two smart building technologies can be integrated and how these can affect the traditional scheduling approach for electrical works.

UNIT 6

WOODWORK TECHNOLOGY

TOOLS AND MACHINES IN THE WOODWORK INDUSTRY

Introduction

This unit will help you to understand how to care for and maintain machines used in the woodwork shop. Proper maintenance is important to keep machines working well, lasting longer, and operating safely. In woodworking and other industries, machines that are well cared for give accurate results and help prevent accidents or breakdowns. Regular checks can detect problems early, saving time and money on repairs. Only trained and qualified individuals should handle machine maintenance to ensure it is done correctly and safely.

In Year 2, you learned how to care for and maintain hand tools and machines. Now, you are building on that knowledge by showing how to care for and maintain machines through practical demonstration. This helps you gain hands-on skills to keep machines safe, clean, and working properly.

KEY IDEAS

- Always clean tools and machines after use to remove dust and dirt.
- Apply oil to moving parts to reduce friction and rust.
- Check tools and machines regularly for damage or wear.
- Ensure all nuts, bolts, and screws are properly tightened before use.
- Keep cutting edges sharp for better performance and safety.
- Keep tools and machines in a dry, safe place to avoid damage.

CARE AND MAINTENANCE OF SPECIFIC MACHINES

Taking good care of machines is not just important; it is a necessity. In every woodworking workshop, the condition of your machine can be the difference between clean, quality work and dangerous accidents. Whether it is a traditional tool or a modern CNC machine, regular care and maintenance keep machines working better, safer, and longer.

In Ghana, the Factories Ordinance of 1952 governs the use of woodworking machines. This law makes sure machines are used safely and maintained properly. Everyone who works with these machines must know and follow these rules. It is not just about keeping machines in shape; it is about protecting yourself and others around you.

Figure 2.6.1: Maintenance on machines

Why Maintenance Matters

Machines that are not cared for can break down, cause injuries, and waste time. But if you clean, lubricate, and check your machines regularly, you will:

1. Get better and faster results
2. Avoid accidents like kickbacks
3. Reduce machine noise
4. Save money on repairs

Maintaining machines also means checking for worn-out parts, testing software (for CNCs), and replacing what is no longer safe to use. After all, a sharp tool cuts well, but a dull or rusty one can ruin your work or worse, hurt you.

Basic Safety Rules Before Maintenance

Before you touch any machine for maintenance, follow safety rules to prevent electric shocks, cuts, burns, or machine damage. These rules also help you do the work properly and safely. ***Table 2.6.1*** shows the key safety steps involved.

Table 2.6.1: Basic Safety Rules Before Maintenance

Description	Reasons
1. Always wear proper PPE such as gloves, goggles, a nose mask, and overalls.	To protect your body, eyes, hands, and lungs from dust, sharp objects, chemicals, and flying particles.

2. Disconnect the machine from the power source before starting maintenance.	To prevent the machine from starting accidentally, which can cause serious injury.
3. Use the correct tools and equipment for servicing the machine.	To avoid damaging the machine or injuring yourself while doing the maintenance.
4. Follow the manufacturer's instructions and procedures.	To carry out the maintenance safely and correctly according to how the machine is designed.
5. Perform maintenance only when the workshop is free from other activities.	To reduce distractions and avoid accidents that may involve other people.
6. Run a test to confirm the machine is working properly after maintenance.	To make sure the machine is safe, working well, and ready to use again.

General Maintenance Tips for CNC Woodworking Machines

Good maintenance makes machines last longer, work better, and stay safer in the workshop. CNC machines, in particular, need special care because they have advanced parts and software. ***Table 2.6.2*** shows how to maintain woodworking machines, especially CNC types, and keep them in top shape.

Table 2.6.2: *General Maintenance Tips for CNC Woodworking Machines*

Description	Reasons
1. Always wear appropriate PPE (nose mask, gloves, goggles, overall, etc.)	To protect yourself from dust, sharp parts, and harmful materials during maintenance.
2. Remove dust, chips, shavings, and debris after each use	To prevent clogging, overheating, and wear on moving parts.
3. Regularly check electrical components, belts, and safety features.	To ensure all parts are working well and reduce the risk of breakdowns or accidents.
4. Refer to the machine's manual for maintenance schedules and procedures	To follow the correct steps and avoid damaging the machine.
5. Monitor software and firmware updates	To improve machine performance and fix any software errors.
6. Store tools and accessories in dry, organised conditions	To protect them from rust, damage, or getting lost.
7. Ensure operators are trained in both machine use and maintenance	To reduce mistakes and keep the machine safe and efficient.
8. Address issues promptly and replace worn or damaged parts	To stop problems from becoming worse and affecting other parts.

9. Maintain accurate records of maintenance, repairs, and inspections	To track what has been done and plan future maintenance.
10. Lock out and tag machines under maintenance	To prevent others from turning them on accidentally and causing injury.
11. Do not leave the machine unattended while running or slowing down	To respond quickly in case something goes wrong.
12. Establish and enforce safety protocols for operation and maintenance	To create a safe working environment and avoid accidents.

Sharpening Cutters, Blades, and Saws

A sharp blade means smooth, clean cuts. A dull one strains the machine and ruins your work. To keep your cutters and blades ready, observe the following, as shown in ***Table 2.6.3***.

Table 2.6.3: *General Maintenance Tips for Sharpening Cutters, Blades & Saws*

Description	Reason
1. Always wear appropriate PPE (nose mask, gloves, goggles, overall, etc.)	To protect yourself from flying metal particles and sharp edges during sharpening
2. Ensure mortising and drilling bits are sharp and properly aligned	To achieve smooth cutting, accurate holes, and reduce strain on the machine.
3. Regularly test and recalibrate the CNC system for precision	To maintain correct tool movement and avoid errors in drilling or shaping.
4. Prevent rust and wear by applying lubricant to all moving parts	To extend the life of the blades and reduce friction during cutting.
5. Ensure workpiece clamps are in good condition and provide firm support	To hold materials steady during operation and avoid damaging the cutting tools.

Care and Maintenance of Specific CNC Machines

CNC machines are the heart of modern woodworking—precise, powerful, and pricey. But without proper care, even the best machine fails. Each type needs special attention to stay sharp, safe, and smooth. Here's how to take proper care of them:

Mortising/Drilling Machine

This mortising/drilling machine pierces wood with precision, but a dull bit or loose clamp can ruin the craft or risk a hand. These machines demand both sharp eyes and sharper tools. ***Table 2.6.4*** shows how it should be cared for and maintained:

Table 2.6.4: *Care and Maintenance of Mortising/Drilling Machine*

Description	Reasons
1. Always wear protective gear like goggles, gloves, and overalls	To shield eyes and skin from flying chips, dust, and sudden bit slips
2. Sharpen and align drill or mortise bits regularly	To ensure clean, accurate holes and reduce strain on the machine
3. Oil moving parts and bits	To prevent rust and keep drilling smooth and quiet
4. Check and secure material clamps	To avoid shifting wood during drilling, which could damage both the workpiece and the operator
5. Recalibrate the machine when results seem off	To maintain drilling precision and avoid measurement errors
6. Inspect for loose bolts, frayed wires, or faulty switches	To prevent unexpected breakdowns and electrical hazards

Grinding Machines

This grinding machine shapes and sharpens, but if the wheel cracks or the coolant fails, chaos follows. Grinding machines need steady hands and steady checks. ***Table 2.6.5*** shows how it should be cared for and maintained:

Table 2.6.5: Care and Maintenance of Grinding Machines

Description	Reasons
1. Always wear appropriate PPE (nose mask, gloves, goggles, overalls, etc.)	To protect your body from sharp particles, sparks, and dust during grinding.
2. Check for cracks or wear on grinding wheels and replace when necessary	To avoid breakage during operation, which can lead to accidents.
3. Ensure wheels are properly balanced and aligned	To reduce vibrations and produce accurate sharpening.
4. Maintain the coolant system to avoid overheating or rusting	To keep the grinding wheel and tool cool and free from damage.
5. Verify that the spindle operates at the correct speed for the task	To ensure the grinding is smooth, safe, and precise.
6. Keep the moving parts lubricated for smooth grinding operations	To reduce friction and wear on the machine parts.

Router Shaping Machines

When you are carving curves or tracing designs, your router must glide like a canoe on calm waters. Dust, dullness, or glitches? Not on your watch. ***Table 2.6.6 o***utlines the proper care and maintenance steps for the machine:

Table 2.6.6: *Care and Maintenance of Router Shaping Machines*

Description	Reasons
1. Always wear appropriate PPE (face mask, gloves, goggles, overalls, etc.)	To stay protected from flying chips, dust, and sharp tools.
2. Ensure bits are sharp and free from damage before use	To achieve smooth shaping and reduce stress on the machine.
3. Apply lubricant to guide rails and bearings	To allow smooth movement and reduce machine wear.
4. Regularly verify the machine's accuracy and recalibrate as needed	To maintain precise cuts and tool alignment.
5. Use a dust collection system to prevent build-up	To keep the workspace clean and avoid clogging or tool damage.
6. Keep the CNC control software updated	To improve machine performance and prevent system errors.

CNC Lathe Machines

The lathe spins stories into shape if it is well-oiled, well-tightened, and well-loved. One slip, and your workpiece or your grade could take a hit. ***Table 2.6.7*** provides detailed guidelines for the care and maintenance of the machine:

Table 2.6.7: *Care and maintenance of CNC Lathe Machines*

Description	Reasons
1. Always wear proper PPE (gloves, goggles, nose mask, overall, etc.)	To stay safe from sharp tools, flying particles, and dust.
2. Ensure the workpiece is securely mounted and the spindle runs smoothly	To avoid accidents and ensure accurate turning.
3. Regularly sharpen cutting tools	To improve cutting efficiency and produce smooth, clean surfaces.
4. Check belt tension and replace worn belts	To maintain steady machine operation without vibration.
5. Remove shavings and debris after use	To avoid a build-up that may affect machine accuracy and tool sharpness.
6. Apply oil or grease to the tool post, tailstock, and guideways	To prevent rust and allow smooth movement of parts.

Drum Sander Machines

Smooth surfaces do not come from luck; they come from a well-tuned drum sander. Clogged dust, loose belts, or noisy rollers? That is a "no-no. Table 2.6.8 outlines the proper care and maintenance steps for the machine:

Table 2.6.8: *Care and maintenance of Drum Sander Machines*

Description	Reasons
1. Always wear proper PPE (gloves, goggles, nose mask, overall, etc.)	To protect against dust and moving parts during maintenance.
2. Monitor abrasives and replace when worn	To ensure even sanding and avoid damaging wood surfaces.
3. Ensure belts are tight and aligned	To prevent uneven sanding and machine stress.
4. Keep the system free from dust clogs	To maintain proper air flow and sanding quality.
5. Lubricate and replace worn-out bearings or rollers	To keep the machine running smoothly and reduce noise.

Activity 2.6.1 Caring for CNC Machines: Maintenance & Safety

Scenario: You are part of a young technical team maintaining your school's woodwork machines. Your task is to research and demonstrate how to maintain CNC machines (router, lathe, sander) safely and correctly. You must explore daily/weekly care routines, identify safety rules, and educate others through creative visual materials and presentations.

Materials Needed

- Short video clips/slides on CNC maintenance and safety
- Real or model CNC router, lathe, sander
- Tools: spanners, screwdrivers, wrenches
- Cleaning gear: cloths, oil, brushes
- PPE (goggles, gloves, aprons, dust masks)
- Maintenance logbooks or sample checklists
- Whiteboards, large paper sheets, and markers
- Internet-enabled devices (optional)
- Design materials (cardboard, glue, coloured pens, etc.)

Activity Guidelines

1. Organise yourself into a group of 4-6 members.

2. Watch a video clip or presentation showing how to care for CNC machines.

3. You choose a partner, form a pair and discuss and record.

   a. Why machine maintenance is important.

   b. What can go wrong if maintenance is ignored?

   c. Key safety rules during maintenance.

4. Use your findings to complete a worksheet or group poster.

5. Copy and complete the following table in your group (sample format):

Machine Name	Daily Maintenance Task	Weekly/Monthly Task	Safety Rule
Router			
Lathe			
Sander			

6. Design a simple poster or mock-up with:

   a. Machine name

   b. Tools/products used

   c. Care schedule (daily/weekly)

   d. Key safety precaution

   e. How it helps extend machine life and protect users

7. In your teams, demonstrate care tasks using real or model machines. Examples:

   a. Dusting and cleaning

   b. Oiling and lubrication

   c. Tightening bolts/screws

   d. Inspecting belts, guards, and cutters

8. Wear PPE at all times.

9. Complete a maintenance checklist or log sheet after each activity.

10. Present your group's poster or mock-up to the class. Explain:

   a. What machine was cared for

   b. Maintenance tasks done and why

   c. Safety rules followed

11. Take questions from classmates and receive peer feedback.

12. Write a personal reflection on:

   a. "One important safety rule you learned is…"

   b. "You now know how to care for a machine by…"

   c. "Next time, you will always remember to…"

Conclusion

Caring for and maintaining machines in the woodwork shop helps them work safely, last longer, and produce quality work. It includes cleaning, checking for damage, applying oil, and tightening loose parts. You have learned how to maintain different CNC machines like the router, lathe, grinder, and sander. You have also looked at the need to wear PPE, disconnect power, and follow safety rules. When machines are well maintained, accidents are reduced, breakdowns are fewer, and work becomes easier and faster. These skills will help to prepare you to work safely and responsibly in real workshops.

EXTENDED READING

- Nur Aqila B. K. Zamal & Hamdi B. H. Mawardi (2024) 3 Axis CNC Router (Operation & Components. Published by Unit Penerbitan. Pages 10-17; 26-31; 44-49. https://web.iitd.ac.in/~jay/dsl732/dsl732_2019/topics/computer_controlled_machining/cncrouter_big_user_manual.pdf

REVIEW QUESTIONS

1. You are a student technician in charge of a new woodwork machine in your school workshop. How will you care for and maintain the new machine?
2. You are assigned to maintain old woodworking machines in the school workshop. How will you care for and maintain the old machines?
3. You are preparing to maintain a CNC woodwork machine in the school workshop. What safety precautions must you follow during maintenance?
4. Why is it important to care for and maintain machines?
5. What are some basic ways to maintain woodworking machines?
6. What should you do before maintaining a powered machine?

UNIT 7

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

Installing a cold-water supply system is a crucial aspect of building services engineering that ensures safe, reliable, and efficient delivery of potable water to residential, commercial, or industrial facilities. The schedule of work involved in this process outlines a systematic sequence of activities, from initial planning to final testing, designed to ensure the proper integration of cold-water infrastructure within the broader construction timeline.

This typically begins with assessing site conditions and water demand, followed by detailed system design, material selection, and coordination with local utilities. Subsequent stages involve laying pipework, fitting valves and storage tanks, and conducting pressure and hygiene tests to meet regulatory standards. Timely execution of each phase is essential to avoid delays and ensure water quality and functionality.

In Year 2, you studied excavation. This is important and linked to the schedule of work involved in the installation of the cold-water supply. All cold-water installation scheduling involves excavation, trenching and pipe laying, connecting to the water main, installing distribution pipes, and connecting to fixtures. The process, therefore, involves excavation as a key factor in the installation of cold-water systems.

KEY IDEAS

- **Planning and Design:** Assess site requirements, create detailed system drawings, and pipe layouts.
- **Material Procurement:** Order and deliver pipes, fittings, valves, and other necessary equipment to the site.
- **Pipe Installation:** Lay out and connect cold water pipes according to the approved design, ensuring secure fittings.
- **Testing and Inspection:** Perform pressure and leak tests to verify the system installation.

THE SCHEDULE OF WORKS IN COLD WATER INSTALLATION

A typical cold-water installation schedule involves trenching and pipe laying, connecting to the water main, installing distribution pipes, and connecting to fixtures. The process includes excavation, pipe installation, backfilling, pressure testing, and sanitisation. ***Figures 2.7.1 and 2.7.2*** indicate the pre-installation and final phases of the schedule of work for the cold-water supply.

The pre-installation of a cold-water supply involves the following.

1. Trenching and Pipe Layout
2. Pipe Preparation and Routing
3. Pipework Installation in Foundation

Figure 2.7.1: Pre-Installation of Cold-Water Supply

Figure 2.7.2: Final installation planning of cold-water supply.

Detailed steps can vary based on whether it's a direct or indirect system (using a storage tank).

Table 2.7.1: *Schedule of works in cold water installation*

SCHEDULE OF WORKS IN COLD WATER INSTALLATION	DESCRIPTION
Planning and Preparation	1. **Site Survey:** Assess the site to determine the best route for pipes, considering factors like depth, obstacles, and proximity to other utilities. 2. **Material Selection:** Choose appropriate pipe materials (e.g., copper, PVC, PEX) and fittings based on the project requirements and local regulations. 3. **Permits and Approvals:** Obtain necessary permits and approvals from local authorities before starting any work.
Excavation and Pipe Installation	1. **Trenching:** Excavate trenches to the required depth (typically 750mm to 1350mm) and width, ensuring proper bedding and backfilling material (sand or soft earth, not rubble). 2. **Pipe Laying:** Install the main supply pipe from the water meter or boundary to the building, including any necessary bends, joints, and supports. 3. **Connection to Water Main:** Connect the main supply pipe to the water main, following the procedures and regulations of the local water authority. 4. **Distribution Piping:** Install branch pipes from the main supply to individual fixtures, ensuring proper slopes for drainage and air vents. 5. **Concealing Pipes:** Where possible, conceal pipes within walls, ceilings, or service shafts, ensuring they are accessible for maintenance. 6. **Insulation:** Insulate cold water pipes to prevent condensation and heat loss, especially in areas prone to temperature fluctuations.
Fittings and Fixtures	1. **Valves and Fittings:** Install all necessary valves (e.g., stopcocks, isolation valves) and fittings according to the design and local codes. 2. **Fixture Connections:** Connect the distribution pipes to the sanitary fixtures (sinks, toilets, etc.), ensuring proper connections and clearances. 3. **Pressure Testing:** Pressure test the entire system to 1.5 times the working pressure for at least an hour to check for leaks. 4. **Sanitisation:** Sanitise the pipework to remove any debris or contaminants before connecting to the potable water supply. 5. **Final Inspection:** Conduct a final inspection to ensure all work is completed according to the design and specifications.

Testing and Commissioning	1. **Pressure Testing:** Pressure test the entire system to 1.5 times the working pressure for at least an hour to check for leaks. 2. **Sanitisation:** Sanitise the pipework to remove any debris or contaminants before connecting to the potable water supply. 3. **Final Inspection:** Conduct a final inspection to ensure all work is completed according to the design and specifications.
Post-Installation	1. **Documentation:** Keep records of all work, including drawings, specifications, and test results. 2. **Maintenance:** Regularly inspect and maintain the system to ensure its proper functioning.
Important Considerations	1. **Safety:** Prioritise safety throughout the installation process, following all relevant safety guidelines and regulations. 2. **Code Compliance:** Ensure that all work complies with local building codes and plumbing standards. 3. **Professional Installation:** Engage qualified and experienced plumbers for cold water installation to ensure quality and reliability.

THE PHASES OF WORK INVOLVED IN THE SCHEDULE OF WORK FOR COLD WATER INSTALLATION

The phases of work involved in a cold-water installation schedule for buildings typically include: design and planning, material procurement, site preparation, pipework installation, fixture installation, testing and commissioning, and finally, handover and documentation.

Table 2.7.2: *Phases of work involved in the schedule of work for cold water*

PHASES OF WORKS	DESCRIPTION
Design and Planning	1. **Needs assessment:** Determine the water requirements of the building, including the number of occupants, fixtures, and potential future needs. 2. **System design:** Develop a detailed plan for the cold water system, including pipe sizing, routing, fixture locations, and water pressure requirements. 3. **Code compliance:** Ensure the design adheres to local plumbing codes and regulations.

Material Procurement	1. **Ordering materials:** Purchase all necessary pipes, fittings, valves, fixtures, and other components based on the design specifications. 2. **Inventory management:** Track materials to ensure timely delivery and prevent delays.
Site Preparation	1. **Clear the area:** Remove any obstacles or debris that may hinder the installation process. 2. **Excavation:** Dig trenches or create openings for pipe runs and fixtures. 3. **Protection:** Safeguard existing structures and utilities during excavation.
Pipework Installation	1. **Layout and support:** Install pipes according to the approved drawings, ensuring proper support and alignment. 2. **Jointing:** Connect pipes using appropriate methods, such as threading, soldering, or welding, depending on the pipe material. 3. **Routing:** Route pipes through walls, floors, and ceilings as required by the design. 4. **Pressure testing:** Conduct pressure tests to identify and rectify any leaks before proceeding.
Fixture Installation	1. **Installation:** Install sinks, toilets, showers, and other fixtures according to manufacturer's instructions. 2. **Connection:** Connect fixtures to the water supply lines, ensuring proper sealing and connections.
Testing and Commissioning	1. **Functional testing:** Verify the proper operation of all fixtures and valves. 2. **Sanitation:** Ensure the system is clean and free of debris before use. 3. **Final inspection:** Conduct a thorough inspection to confirm compliance with all requirements.
Handover and Documentation	1. **System handover:** Provide the building owner with the necessary documentation, including as-built drawings and maintenance instructions. 2. **Training:** Offer training on the operation and maintenance of the new cold-water system.

Activity 2.7.1 Exploring the Schedule of Works in Cold Water Installation

Scenario: Imagine you are part of a building services team working on a new residential apartment. Your team's job is to ensure that the cold-water supply system is installed correctly. To succeed, you and your group must explain the

schedule of works, identify each stage from planning to installation, and show why following the correct order guarantees safe and reliable water for residents.

Materials Needed

- Chart paper/whiteboard + markers
- Sticky notes for brainstorming stages of work
- Diagrams of cold water installation systems (pipes, tanks, valves, taps, meters)
- Brochures/printed guides from Ghana Water Company Limited (GWCL) or plumbing handbooks
- Short video clips on plumbing installations
- Notebooks and pens

Activity Guidelines

1. Organise yourselves into a group of 3-5 members.
2. With your group, discuss the following question: "***What steps must be followed before, during, and after cold water installation***?"
3. Write one step on a sticky note (e.g., site survey, material selection, pipe laying, leak testing, inspection).
4. Stick notes on chart paper to build a group pool of ideas.
5. As a group, group the sticky notes into two categories:
   a. Pre-Installation Planning (surveying site, designing layout, preparing materials).
   b. Final Phases of Installation (pipe fitting, connection to main supply, testing for leaks, inspection).
6. Draw your own mini flowchart in your notebook showing the correct sequence.
7. With your group, design a simple flowchart or diagram on chart paper showing the phases of cold water installation.
8. Add drawings/symbols (pipes, tanks, taps) to make it clear.
9. Write a one-sentence caption under the diagram explaining one stage in your own words.
10. Watch a video or (if possible) take a field trip to observe how cold water systems are installed.
11. You should note at least two real-life practices that match the schedule of work discussed in class.
12. In your group, present your schedule of work to your class. Your presentation should take 3–5 minutes.

13. Each group member should explain one stage of the schedule and why it matters.
14. In your notebook, write a short answer to this question: "Why is following a proper schedule of work important in cold water installation?"

Conclusion

A proper schedule of work in cold water installation ensures that water is supplied safely, reliably, and efficiently in buildings. The process begins with planning and preparation, followed by excavation and pipe laying, then connecting fittings and fixtures, and finally testing, commissioning, and maintenance. Each phase must follow the correct order so that the system works without leaks, contamination, or interruptions. Understanding and following this schedule is important because it helps to guarantee safe drinking water, prevents costly repairs, and ensure compliance with building standards.

REVIEW QUESTIONS

1. A building requires a cold-water installation to be completed within a tight timeframe. Evaluate the three most critical factors that must be considered when scheduling.
2. A client requires the integration of smart building technologies into the cold-water installation of a building. Evaluate how any two smart building technologies can be integrated and how these can affect the traditional scheduling approach for cold-water installation works.

UNIT 8

WOODWORK TECHNOLOGY

MATERIALS AND ARTEFACTS PRODUCTION IN THE WOODWORK INDUSTRY IN GHANA

Introduction

In this unit, you will find out where and how to access Lesser-Known Timber Species (LKS), Lesser-Used Timber Species (LUS), and Non-Timber Forest Products (NTFPs). These are wood types and forest resources that are not widely used but have good or even better qualities than commonly used timber. In Ghana, using these underutilised species is becoming important to reduce the overuse of popular timber and to promote the sustainable use of our forests.

KEY IDEAS

- Availability depends on region and climate, as some species grow only in certain forest zones of Ghana.
- Community forests and reserves are common sources of LKS, LUS, and NTFPs.
- Education on local species helps people recognise and make good use of lesser-known timber and forest products.
- Lesser-known and lesser-used species are often underutilised but can serve as good alternatives to popular timber.
- Non-timber forest products like bamboo, honey, and medicinal plants are gathered without cutting down trees.
- Sustainable harvesting practices ensure these resources remain available for future generations.

DETERMINATION OF LESSER-KNOWN TIMBER SPECIES (LKS), LESSER USED TIMBER SPECIES (LUS) AND NON-TIMBER FOREST PRODUCT (NTFP)

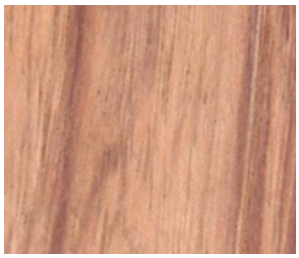
Lesser-known and lesser-used species are timber types from Ghana that are not commonly used but have similar or even better qualities than popular ones. Although there are over 50,000 timber species in the world, only a small number are used for

commercial purposes. In Ghana, about 90 species are regularly harvested and sold as timber. However, many lesser-used species can perform just as well or even better for certain uses, and they often have a unique look. Using these species is a smart business choice that can also help protect the environment and improve people's lives. The ***Table 2.8.1*** below displays Some Ten (10) Lesser-Known and Lesser-Used Species

Table 2.8.1: *Some Ten (10) Lesser-Known and Lesser-Used Species*

Species name/ Properties	Image	Availability	Sources
1. **AFINA** • **Durable**: Strong and long-lasting • **Easy to Work**: Cuts and shapes well • **Low Abrasiveness**: Gentle on tools • **Heavy**: Medium to high density • **Good Finish**: Smooth and takes polish well • **Neat Grain**: Straight and attractive	 • **Scientific name: *Strombosia glaucesens***	• These species are found in Ghana's natural forests. • Log production follows sustainable forest management rules. • Ghana allows only 300,000 cubic metres of round logs to be harvested per year. • The logs are processed into lumber, poles, and veneer within this limit.	• They are harvested from legally managed forest reserves across the country. • The Forestry Commission ensures the logs come from approved areas. • Local timber companies and wood markets supply these species under forest regulations. • These sources support responsible logging and environmental protection.
2. **ALSTONIA** • **Soft and Light**: Easy to carry and work with • **Low Durability**: Not good for outdoor use unless treated • **Very Easy to Work**: Cuts, nails, and sands easily • **Low Abrasiveness**: Does not wear out tools quickly • **Low Density**: Feels light and less strong • **Smooth Finish**: Paints and polishes well	 • **Scientific name: *Alstonia boonie***	• These species are found in Ghana's natural forests under proper management. • Log production follows the Ghana forest management standard. • The annual allowable cut is 178,900 m^3 to protect the forest from overuse. • Logs are processed into lumber, veneer, and plywood.	• They are harvested from sustainably managed forest reserves across Ghana. • The Forestry Commission monitors and approves the harvesting areas. • Timber companies and licensed sawmills supply these species to the market. • Local wood markets may also sell these lesser-used species legally.

3. **DANTA / (KOTIBE')** • **High Durability**: Strong and lasts long, even in tough weather • **Good Workability**: Can be cut and shaped with some effort • **Medium Abrasiveness**: May slightly wear tools over time • **High Density**: Heavy and strong wood • **Good Finish**: Takes polish and paint well	 • **Scientific name: *Nesogordonia papaverifera***	• These species are found in Ghana's natural forests. • Log production follows the Ghana forest management standard. • The yearly limit for cutting round logs is 120,000m^3 to protect forest resources. • The logs are turned into lumber, veneer, and plywood for use.	• They are taken from approved forest areas managed by the Forestry Commission. • Only licensed timber firms are allowed to harvest and process these species. • They are sold through registered sawmills and wood markets across Ghana. • These sources ensure the wood is legal and sustainably harvested.
4. **RED OAK /** (KWATAFOMPABOA) • **Durability:** Strong but not as weather-resistant • **Workability:** Easy to cut, nail, and glue • **Abrasiveness:** Low gentle on tools • **Density:** Medium to heavy • **Finishing:** Excellent stains and polishes beautifully	 • **Scientific name: *Berlinia confuse***	• These species grow in Ghana's natural forests and are harvested carefully. • Logging is done under the Ghana forest management standard to protect the environment. • The allowed amount of log harvest each year is 60,000m^3. • These logs are processed into lumber, veneer, and plywood.	• The species are harvested from government-approved forest reserves. • The Forestry Commission ensures harvesting follows legal and sustainable practices. • Licensed timber companies and sawmills supply these species to the market. • Legal wood markets in Ghana also sell them for construction and carpentry.

5. **WATAPUO** • **Durability:** Strong and lasts long, even outdoors • **Workability:** Moderate – not too hard, not too soft • **Abrasiveness:** Medium – can slightly dull tools over time • **Density:** Heavy and tough • **Finishing:** Smooth with nice grain; takes polish well	 • **Scientific name:** ***Cola gigantea***	• These species are found in Ghana's natural forests. • The trees are harvested under the Ghana forest management standard. • The yearly allowed number of logs harvested is 65,400m³. • Logs from these species are mainly converted into lumber.	• They are harvested from certified forest reserves managed by the Forestry Commission. • Only licensed timber firms are allowed to cut and process these trees. • Sawmills and approved timber markets supply the lumber made from these species. • All sources follow legal and sustainable logging practices.
6. **APOME/ (ANANTA)** • **Durability:** Fairly durable, but best for indoor use • **Workability:** Easy to cut, shape, and nail • **Abrasiveness:** Low – gentle on tools • **Density:** Light to medium weight • **Finishing:** Smooth surface; easy to paint or polish	 • **Scientific name:** ***Cynometra Ananta***	• These species are found in Ghana's natural forests under sustainable management. • Log production is guided by the Ghana forest management standard. • The annual allowable cut is estimated at 248,000m³. • The logs are mainly processed into lumber and poles for building and utility use.	• The logs come from approved forest reserves managed by the Forestry Commission. • Only licensed companies are allowed to harvest and process these species. • The lumber and poles are supplied by registered sawmills and timber markets in Ghana. • All harvesting and supply follow legal and sustainable forest practices.
7. **AVODIRE** • **Durability:** Moderate – lasts well indoors • **Workability:** Very easy to cut, shape, and glue • **Abrasiveness:** Low – tools stay sharp longer • **Density:** Light to medium weight • **Finishing:** Takes polish and paint nicely	 • **Scientific name:** ***Turraeanthus africanus***	• These species are available in Ghana's natural forests managed sustainably. • Log harvesting follows the Ghana forest management standard. • The annual allowable cut is limited to 16,000m³ to protect the forest. • The harvested logs are processed into lumber, veneer, and plywood.	• Logs are obtained from government-approved forest reserves. • The Forestry Commission ensures that only legal and sustainable harvesting is done. • Registered sawmills and licensed timber companies process and sell these species. • They are available in approved timber markets across Ghana.

8. **DENYA / (OKAN)** • **Durability:** Very high – resists rot, insects, and weather • **Workability:** Difficult – hard to cut and nail • **Abrasiveness:** High – quickly dulls tools • **Density:** Very heavy and strong • **Finishing:** Needs effort to polish well	 • **Scientific name: *Cylicodiscus gabunensis***	• These species grow in Ghana's natural forests and are harvested responsibly. • Logging follows the Ghana forest management standard to protect forest resources. • The approved annual log harvest is 500,000m³. • These logs are mainly processed into lumber and poles.	• The logs come from sustainably managed forest reserves approved by the Forestry Commission. • Only licensed timber firms are allowed to harvest and process them. • The lumber and poles are supplied through registered sawmills and timber markets. • All sources follow legal and sustainable forestry practices in Ghana.
9. **EFFEU** • **Durability:** Moderate – can last but not the best outdoors • **Workability:** Fair – easy to cut and shape with sharp tools • **Abrasiveness:** Low – gentle on tools • **Density:** Medium – not too heavy • **Finishing:** Accepts paint and polish well	 • **Scientific name: *Hannoa Klaineana***	• These species are found in Ghana's natural forests and are harvested sustainably. • Log production follows the Ghana forest management standard. • The annual allowable cut is estimated at 65,500m³. • The harvested logs are converted into lumber, billets, veneer, and plywood.	• They come from approved forest reserves under the supervision of the Forestry Commission. • Only licensed timber firms are allowed to harvest and process these logs. • The wood products are supplied by registered sawmills and timber markets in Ghana. • All harvesting activities follow legal and environmentally friendly practices.
10. **WAWABIMA / (BROWN STERCULIA)** • **Durability:** Low – not long-lasting outdoors • **Workability:** Very good – easy to saw, nail, and shape • **Abrasiveness:** Low – smooth on tools • **Density:** Light – easy to carry and handle • **Finishing:** Takes polish and paint well	 • **Scientific name: *Sterculia rhinopetala***	• These species are found in Ghana's natural forests managed sustainably. • Log production follows the Ghana forest management standard to protect the forest. • The annual allowable cut is estimated at 170,000m³. • Logs are processed into lumber, veneer, and plywood.	• The species are harvested from approved forest reserves monitored by the Forestry Commission. • Only licensed timber firms are permitted to cut and process these trees. • Sawmills and timber markets across Ghana supply the processed wood products. • All harvesting is done legally and supports forest conservation.

Non-Timber Forest Products (NTFPs) are useful natural items collected from forests that are not timber or wood. They come from plants and animals found in natural forests, plantations, and agroforestry areas. Examples of NTFPs include fruits, nuts, seeds, medicinal plants, resins, oils, fibres, mushrooms, and honey. Some animal products like bush meat, fish, and game are also considered NTFPs. In addition, products like bamboo, rattan, and other palms and grasses are part of this group. These items play an important role in supporting local livelihoods, medicine, food, and income generation in many communities across Ghana.

NTFPs are useful forest products that are not timber or wood. ***Table 2.8.2*** shows the Availability and Sources of NTFPs

Table 2.8.2: *Availability and Sources of NTFPs*

Availability and Sources	Description
Availability of NTFPs depends on:	**1.** Different forests like rainforests, savannahs, and wetlands provide different types of NTFPs. **2.** Many NTFPs are seasonal and only available during certain times of the year, such as mushrooms and fruits. **3.** Bad practices like overharvesting, deforestation, and land damage can reduce NTFP supply. **4.** When communities harvest NTFPs carefully and follow good forest practices, the supply can last longer.
Sources of NTFPs include:	**1.** NTFPs are collected from the wild, such as shea nuts, baobab fruit, and dawadawa seeds. **2.** Some are grown with crops or in home gardens, like moringa leaves, herbal medicines, and honey from beehives. **3.** Others are grown on purpose in plantations, such as bamboo, rattan, cashew, and neem. **4.** Sacred groves and protected areas also provide NTFPs like wild herbs and spices, used sustainably by local people.

Activity 2.8.1 Exploring Ghana's Forest Treasures for Sustainable Living

Scenario: You are a young forestry ambassador working with the Ghana Forestry Commission. Your team has been invited to help raise awareness in your community about underused forest resources. Your goal is to identify *lesser-known wood species and non-timber forest products in Ghana and creatively show how they can bring* jobs, income, and protect the environment.

Materials Needed

- Pre-recorded video/slides on LKS, LUS & NTFPs
- Printed fact sheets/posters of forest species and products
- Markers, sticky notes, drawing tools
- Large paper sheets or cardboards
- Internet-enabled devices (if available)
- Design materials (glue, scissors, coloured pens, etc.)
- Reflection worksheet or journal
- Teacher's assessment checklist

Activity Guidelines

1. Organise yourself into a group of 4 members.

a. Watch the short video or review posters on LKS, LUS, and NTFPs in Ghana.

b. Use your own words to define:

i. Lesser-Known Timber Species (LKS)

ii. Lesser-Used Timber Species (LUS)

iii. Non-Timber Forest Products (NTFPs)

iv. List three examples of each from your locality.

2. Visit the local forest belt or use the internet to research LKS, LUS and NTFS in your region. Copy and complete the following table in your notebook:

Lesser-Known Timber Species (LKS)	Lesser-Used Timber Species (LUS)	Non-Timber Forest Products (NTFPs)

3. In your group, design a sustainable product by:

a. Choosing one LKS/LUS and one NTFP.

b. Creating a product concept that combines both items (e.g. a stool made from LKS and decorated with shea butter polish).

c. Using paper or cardboard to sketch or mock-up a poster showing:

i. Product name

ii. Materials used

   iii. Who it helps and how
   iv. Economic benefit
   v. Environmental impact

4. Present your poster/mock-up to the class.
5. Explain;
   a. Where the forest resources are found
   b. Why they're useful
   c. How can they be protected and used sustainably
6. Respond to class questions and suggestions.
7. Write in your notebook or reflection sheet and respond to:
   a. "One forest resource you didn't know about before was…"
   b. "The most surprising use of a forest product was…"
   c. "You think your community can promote this resource by…"

Conclusion

Lesser-Known Timber Species (LKS), Lesser Used Timber Species (LUS), and Non-Timber Forest Products (NTFPs) are important forest resources found across different forest zones in Ghana. These include timber from lesser-known trees and useful products like bamboo, honey, fruits, and herbs that are not made from wood. They are often found in natural forests, forest reserves, plantations, and home gardens. Their availability depends on location, season, and how they are managed. Using these resources wisely helps protect popular trees, supports local livelihoods, and ensures that forests stay healthy for future generations.

EXTENDED READING

- Council for Scientific and Industrial Research (CSIR) 2016. Lesser-Known & Lesser-Used Timber Species, Ghana. Pages 10-45

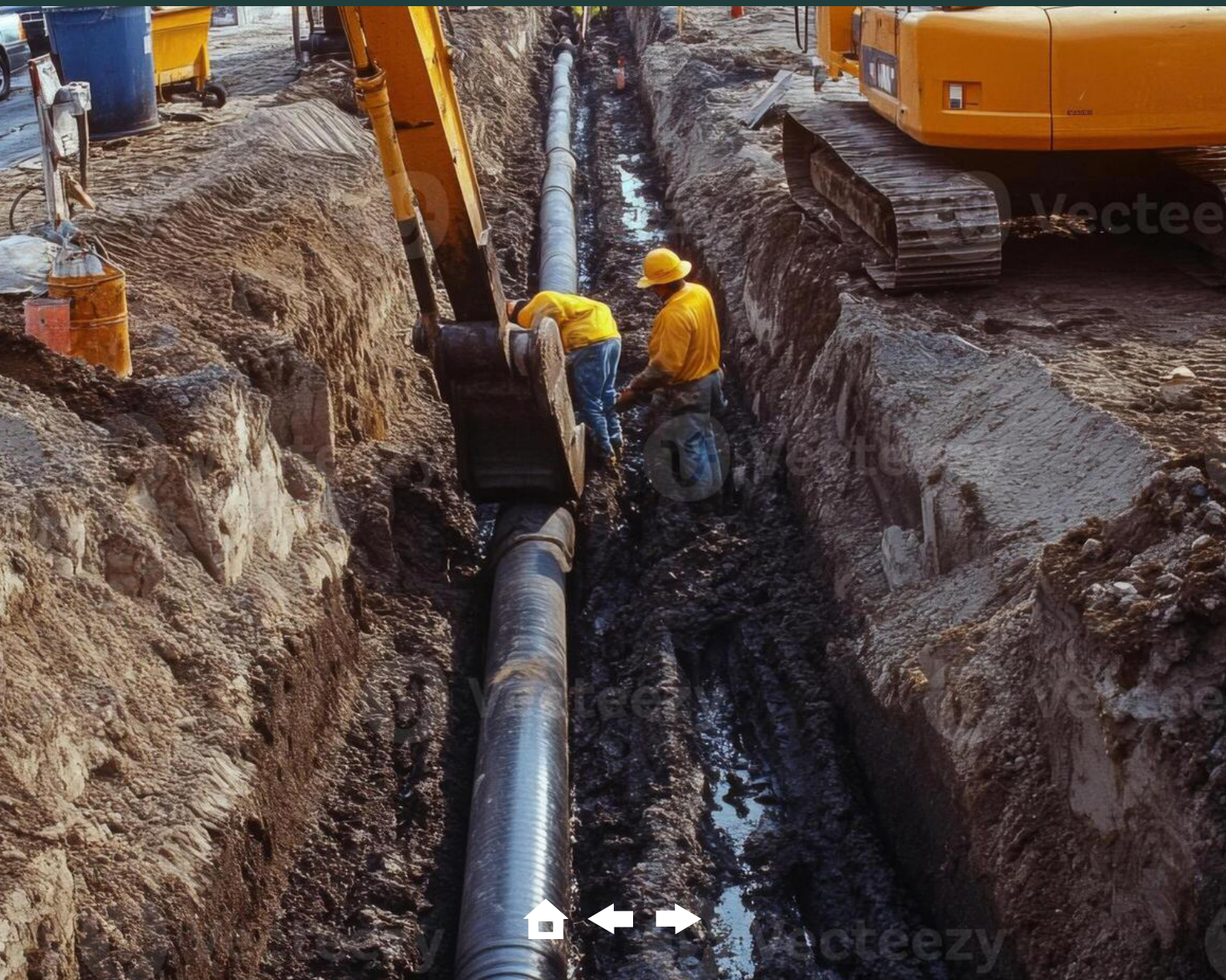
REVIEW QUESTIONS

1. Imagine you are part of a school woodwork club tasked to explore natural resources in Ghana. You are asked to research three lesser-known timber species (LKS), lesser-used species (LUS), and one non-timber forest product (NTFP).
   a. What simple plan can you create?
   b. How are these materials harvested, processed and used for woodwork products?
2. Where in Ghana can Lesser-Known and Lesser-Used Timber Species be found?
3. What affects the availability of Non-Timber Forest Products (NTFPs)?
4. What are the main sources of NTFPs in Ghana?

SECTION

3

WASTE DISPOSAL, DRAINAGE SYSTEM IN BUILDING AND LKS, LUS, NTFPs



UNIT 9

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

A Waste Disposal Work Schedule is a clear plan that outlines how and when waste is collected, treated, and safely removed. It helps keep communities clean, protects public health, and ensures the environment is not harmed. This schedule is especially important for managing wastewater and sewerage, which come from homes, businesses, and industries. Wastewater includes dirty water from sinks, toilets, and drains, while sewerage refers to the system of pipes and treatment plants that carry and clean this water. If not handled properly, wastewater can cause pollution and spread disease. A good work schedule makes sure that sewer systems are regularly checked, cleaned, and repaired. It also ensures that wastewater is treated before being released back into nature. By following a proper schedule, cities and towns can avoid blockages, flooding, and contamination, keeping the environment and people safe.

Prior knowledge about excavation will enable you to understand that most waste disposals are effectively carried out in well-excavated trenches.

KEY IDEAS

- Set regular collection times for household, industrial, and medical waste to avoid buildup and health risks.
- Assign specific routes and vehicles for waste collection to ensure efficient and timely service.
- Include routine cleaning and maintenance of waste bins, trucks, and disposal sites to prevent odours and pests.
- Schedule regular inspection and cleaning of sewer lines and wastewater systems to prevent blockages and leaks.
- Plan timely treatment and disposal of collected waste at approved facilities to protect the environment and public health.

THE SCHEDULE OF WORKS INVOLVED IN WASTE DISPOSAL

Effective waste disposal in building construction involves a systematic approach encompassing waste identification, segregation, storage, transportation, treatment, and disposal, with a focus on minimising environmental impact and adhering to legal requirements. ***Table 3.9.1*** clearly shows the schedule of work involved in waste disposal. ***Figures 3.9.1 to 3.9.3*** are examples of waste disposal systems.

Figure 3.9.1: Example of laid waste pipes

Figure 3.9.2: Laid waste pipes connected through a manhole, a septic tank and a soakaway

Figure 3.9.3: Example of sewerage disposal

Table 3.9.1: *Schedule of work involved in waste disposal*

SCHEDULE OF WORKS	DESCRIPTION
Effective Planning and Preparation	**1.** Proper Waste Segregation **a.** **Separate waste into categories:** organic, recyclable, hazardous, and general waste. **b.** Use colour-coded bins to make sorting easy. **2.** Regular Collection and Transport **a.** Maintain a consistent schedule for waste pickup. **b.** Use covered and well-maintained vehicles to prevent spillage. **3.** Public Awareness and Education **a.** Teach communities about proper disposal methods. **b.** Promote recycling and composting through campaigns and school programmes. **4.** Efficient Wastewater and Sewerage Management **a.** Clean and inspect sewer systems regularly. **b.** Treat wastewater before releasing it into the environment. **5.** Use of Approved Disposal Sites **a.** Dispose of waste only at licensed landfills or treatment centres. **b.** Avoid illegal dumping to prevent pollution and health hazards. **6.** Government Policies and Enforcement **a.** Enforce laws on waste handling and littering. **b.** Support waste management programs with funding and oversight.

On-site Waste Management	1. **Segregation:** Separate waste materials into designated containers (e.g., for hazardous materials, recyclables, inert waste, general waste). 2. **Storage:** Ensure proper storage of waste in appropriate containers (e.g., skips, bins, bags), keeping them covered and protected from the weather. 3. **Transportation:** Arrange for the removal of waste by licensed waste carriers. 4. **Treatment and Recovery:** Implement measures for recycling, composting, or other treatment methods where feasible. 5. **Disposal:** Dispose of remaining waste at authorised disposal sites, ensuring compliance with environmental regulations. 6. **Record Keeping:** Maintain records of waste quantities, disposal methods, and any associated documentation (e.g., waste transfer notes). 7. **Spill Control:** Implement procedures for immediate clean-up of spills using appropriate absorbent materials. 8. **Hazardous Waste Management:** Follow specific guidelines for handling and disposing of hazardous materials, including proper labelling and disposal methods.
Continuous Improvement	1. **Seek Feedback:** Gather feedback from site personnel and stakeholders to identify areas for improvement. 2. **Implement Best Practices:** Adopt new technologies and methodologies for waste reduction and management.

THE DIFFERENCE BETWEEN SOLID WASTE AND LIQUID WASTE

Solid waste is discarded material in a solid state, like garbage and trash, while liquid waste is discarded material in a liquid state, like wastewater and sewage. Solid waste is typically collected and disposed of, while liquid waste often requires treatment before disposal or reuse. ***Table 3.9.2*** shows the differences between solid and liquid waste.

Table 3.9.2: *Difference between solid and liquid waste*

DIFFERENCE	DESCRIPTION
Solid Waste	1. **Definition:** Anything discarded in a solid form, including items like paper, plastic, glass, metals, food scraps, yard waste, and construction debris. 2. **Examples:** Household garbage, industrial waste, agricultural waste, construction and demolition debris. 3. **Management:** Solid waste management involves collection, transportation, processing, and disposal, often through methods like landfills, incineration, or recycling. 4. **Characteristics:** Can be biodegradable (decomposes naturally, like food waste) or non-biodegradable (doesn't decompose easily, like plastic).

Liquid Waste	1. **Definition:** Wastewater from various sources, including domestic sewage, industrial effluents, and agricultural runoff. 2. **Examples:** Wastewater from sinks, showers, toilets, and industrial processes; runoff from rain; leachate from landfills. 3. **Management:** Liquid waste management focuses on treatment to remove contaminants before discharge into the environment or reuse. 4. **Characteristics:** Can contain organic matter, pathogens, and chemicals, requiring treatment processes like filtration, chemical treatment, or biological treatment.

The Difference Between Pre-Installation Planning Phase and Final Installation Planning Phase

The pre-installation planning phase focuses on establishing the framework and strategy for waste management, while the final installation planning phase concentrates on the practical, on-site aspects of implementing that strategy. The pre-installation phase sets goals, identifies resources, and outlines procedures, while the final phase ensures these procedures are executed effectively during the actual waste management process.

Table 3.9.3: *Difference between pre-installation planning phase and final installation phase*

DIFFERENCE	PURPOSE	KEY ACTIVITIES	EXAMPLE
Pre-Installation Planning Phase	To develop a comprehensive waste management strategy before any physical waste management activities begin.	• **Waste Audit:** Identifying the types, quantities, and sources of waste generated. • **Goal Setting:** Defining clear objectives for waste reduction, reuse, recycling, and disposal. • **Resource Allocation:** Determining the necessary resources (personnel, equipment, budget) for implementation. • **Procedural Development:** Establishing guidelines for waste segregation, collection, transportation, and final disposal. • **Stakeholder Engagement:** Involving relevant parties (e.g., employees, contractors, waste management providers) in the planning process.	Determining the optimal location for waste storage containers, establishing a system for tracking waste generation, and selecting appropriate disposal methods based on waste types.

Final Installation Planning Phase	To translate the pre-installation plan into practical, on-site actions during the waste management process	• **Site Preparation:** Ensuring the designated waste storage and handling areas are properly prepared and equipped. • **Implementation of Procedures:** Executing the waste management plan, including waste segregation, collection, and transportation. • **Monitoring and Reporting:** Tracking waste generation and disposal activities to ensure compliance with the plan and identify areas for improvement. • **Contingency Planning:** Addressing unforeseen issues or challenges that may arise during the waste management process.	Ensuring waste is properly segregated into designated bins, coordinating waste collection schedules, and managing the final disposal of waste at designated facilities.

The Testing of Pipe Systems and Points of Waste Disposal

Testing pipe systems for leaks and proper function, as well as identifying appropriate waste disposal points, is crucial for ensuring safe and efficient plumbing and drainage. This involves various methods, including visual inspections, pressure testing (hydrostatic or pneumatic), and tests for flow and capacity. Waste disposal points need to be carefully considered to prevent contamination and environmental damage. Details of the testing pipe system and points of waste disposal are outlined in ***Table 3.9.4.***

Table 3.9.4: *Testing of pipe system points of waste disposal*

PIPE SYSTEM	DESCRIPTION
Pipe System Testing Methods	1. **Visual Inspection:** A thorough visual examination of the pipe system, including joints and connections, can reveal visible leaks, cracks, or other damage. 2. **Pressure Testing:** a. **Hydrostatic Testing:** The system is filled with water and pressurised to a specified level (often higher than normal operating pressure) to check for leaks. Pressure is monitored for a period to identify any drops, which indicate leaks. b. **Pneumatic Testing:** Similar to hydrostatic testing, but uses air pressure. This method may be used when water is not practical. 3. **Flow and Capacity Tests:** These tests assess the ability of the system to handle the intended flow of water or waste, ensuring proper drainage and preventing blockages. 4. **Other Tests:** Depending on the specific system and application, other tests may be employed, such as ultrasonic testing for wall thickness and internal condition, or smoke testing for leak detection.

Points of Waste Disposal	1. **Connection to Municipal Sewer System:** For wastewater, connection to a properly designed and permitted public sewer system is the preferred method, ensuring safe and regulated disposal. 2. **Septic Systems:** In areas without access to a public sewer, properly designed and maintained septic systems can be used for wastewater disposal. 3. **Stormwater Drainage:** Stormwater runoff should be directed to appropriate locations, such as designated storm drains or retention ponds, to prevent flooding and erosion. 4. **Proper Disposal of Hazardous Waste:** Specialised procedures and facilities are required for the disposal of hazardous materials, such as chemicals or medical waste, to prevent environmental contamination. 5. **Consideration of Local Regulations:** All waste disposal practices should adhere to local regulations and environmental guidelines to ensure responsible disposal.

Activity 3.9.1 Understanding the Schedule of Works in Waste Disposal

Scenario: You are a plumbing technician on a new building project. Your task is to plan and explain the schedule of work for waste disposal systems. You must ensure that foul waste and surface water are separated, the right materials are used, and the pipe systems are tested before the building is occupied. Working in groups, each member should contribute individually to build a complete picture of how waste disposal systems are safely installed and maintained.

Materials Needed

- Chart paper/whiteboard and markers
- Sticky notes for brainstorming
- Diagrams of foul waste and surface water systems
- Sample PVC pipes, connectors, and fittings
- Short video clips of construction plumbing installations
- Notebooks and pens
- (Optional) Site visit or observation video of plumbing installation

Activity Guidelines

1. Organise yourself into a group of 4 members.
2. In your group, write on sticky notes: “What are the step-by-step works needed in waste disposal installation?”

3. Stick notes on chart paper. As a group, arrange them into a sequence (e.g., survey → design → material selection → pipe laying → inspection → testing).
4. Assign a specific role to each group member:
   a. Schedule Analyst: Outlines the sequence of work from pre-installation to final testing.
   b. System Differentiator: Explains the differences between foul waste and surface water disposal.
   c. Phase Comparator: Compares the Pre-Installation Planning Phase with the Final Installation Phase.
   d. Testing Officer: Describes how systems are tested (leak detection, flow tests, inspection).
5. After research and discussion, you and your group members combine findings into one chart/table.
6. Watch a short video (or undertake a site visit if available).
7. Write at least two observations about how technicians separate foul verses surface water and follow the schedule of works.
8. As a group, prepare a flowchart under four headings:
   a. Schedule of Works
   b. Foul Waste versus Surface Water
   c. Pre versus Final Phase
   d. Testing and Disposal Points
9. Write a personal summary in your notebook: "The most important step in waste disposal installation is… because…"
10. With your group, present your chart in 3–5 minutes.
11. During your group's presentation, you speak about your individual role findings.
12. Write a reflection: "Why is it important to separate foul waste and surface water, and to test disposal systems before use?"

Conclusion

The schedule of works in waste disposal is a step-by-step process that ensures waste is managed safely, hygienically, and in line with environmental standards. It begins with planning and segregation of waste into solid or liquid, then moves to storage, collection, and transportation using proper containers and licensed carriers. After this, waste is either treated, recycled, or finally disposed of at approved sites like landfills, septic tanks, or sewer systems.

In construction, the process also includes pre-installation planning (survey, design, material choice) and final installation (laying pipes, connections, inspection, and testing). Pipe systems must be tested for leaks and flow before use, and waste disposal points must follow local regulations to protect public health and the environment.

In short, effective waste disposal is not just about "throwing away," but about planning, separating, treating, testing, and safely disposing so that our buildings remain clean, safe, and sustainable for everyone.

EXTENDED READING

- Chudley, R., & Greeno, R. (1998). Building Construction Handbook (Third Edition). A division of Reed Educational and Professional Publishing Ltd. Woburn, MA 01801-2041. Pages 94-296.
- Hall, F., & Greeno, R. (2007). Building Services Handbook (Fourth Edition). Butterworth-Heineman Elsevier Ltd. Oxford, U.K. Pages 185-215.
- Mike Jones et al. (2022). Building Services Engineering for Construction, Hodder Education, C. O. U.K., Pages 145-158.

REVIEW QUESTIONS

1. A new residential development's waste disposal system requires excavation work scheduled during the rainy season. Analyse how the rain, as a weather condition, can impact the waste disposal installation schedule.
2. Analyse any two drainage test-related challenges which could impact the waste disposal installation work schedule.

UNIT 10

WOODWORK TECHNOLOGY

MATERIALS AND ARTEFACTS PRODUCTION IN THE WOODWORK INDUSTRY IN GHANA

Introduction

Forests give us more than just popular timber like mahogany or Odum. They are full of lesser-known and lesser-used timber species (LKS and LUS) that can also be used for furniture, buildings, and crafts. These lesser-used woods have similar strength and beauty, but are often ignored. Forests also provide many Non-Timber Forest Products (NTFPs) like fruits, seeds, oils, honey, and medicinal plants that help people earn income and stay healthy.

This unit will help you learn how to classify these forest resources, LKS, LUS, and NTFPs, based on their type and use. Knowing how to group and use them wisely can reduce the overuse of well-known timber trees, protect our forests, and support sustainable living. It also helps preserve Ghana's natural resources for future generations.

Earlier in year 3, you learnt how to find out where Lesser-Known Timber Species (LKS), Lesser Used Timber Species (LUS), and Non-Timber Forest Products (NTFPs) come from. Now, you should be able to classify them. That means you can group each one based on its use, type, and source. LKS and LUS are trees not commonly used, but are good for furniture and building. NTFPs are things from the forest that are not wood, like honey, mushrooms, and herbs. Knowing their types helps you use them well and protect the forest.

KEY IDEAS

- **Availability: LKS, LUS, and NTFPs come from forests across Ghana, especially in lesser-known areas.**
- **Benefits: They support local economies and reduce pressure on well-known timber species.**
- **Classification: LKS and LUS are grouped by tree type and wood quality; NTFPs are grouped by product type (e.g. food, medicine, crafts).**
- **Difference: LKS and LUS are wood-based; NTFPs are non-wood items like fruits, herbs, and resins.**
- **Examples**
  - **LKS: Yaya, Dahoma**

- **LUS: Essia, Ananta**
- **NTFP: Shea butter, honey**
- **Forest Use: Proper use of these resources helps conserve biodiversity and fight deforestation.**

THE CLASSIFICATION OF LESSER-KNOWN TIMBER SPECIES (LKS), LESSER USED TIMBER SPECIES (LUS) AND NON-TIMBER FOREST PRODUCT (NTFP)

In Ghana, our forests provide more than just popular timber like mahogany and odum. They also provide other useful trees that people do not often use, called lesser-known and lesser-used timber species. We also harvest many non-timber products, such as honey, mushrooms, shea nuts, and medicinal plants. Learning about these resources helps us use the forest wisely and protect it for future generations.

Classification of Forest Resources with Examples

The forest resources are grouped into three main categories: Lesser-Known Timber Species (LKS), Lesser-Used Timber Species (LUS), and Non-Timber Forest Products (NTFPs).

Lesser-Known Timber Species (LKS)

These are tree species that are not widely known or used in the timber industry. They are often found in Ghana's forests but are underused. Examples include:

a. Afena is suitable for general construction.

b. Watapuo has good strength and appearance.

c. Apoma (Ananta) is used for furniture and light construction.

d. Effeu is useful for carpentry and joinery.

e. Wawabima (Brown Sterculia) is light but easy to work with.

Lesser-Used Timber Species (LUS)

These are known but not frequently used, either because people are unfamiliar with their value or because they are not promoted. ***Examples include:***

a. Avodire is decorative and smooth, good for cabinets.

b. Danta (Kotibe') is heavy, hard, and durable.

c. Red Oak (Kwatafompaboa) is good for flooring and furniture.

d. Denya (Okan) is very strong, ideal for outdoor work.

e. Alstonia is light and easy to cut, used in ceilings and soft structures.

Classifying Lesser-Known Timber Species (LKS) and Lesser-Used Timber Species (LUS)

We classify Lesser-Known Timber Species (LKS) and Lesser-Used Timber Species (LUS) based on their different characteristics or properties. These help us understand how the wood looks, behaves, and performs when used in construction, furniture, or other work. The four main areas of classification are: appearance, physical properties, strength, and performance.

Appearance (How the wood looks)

This helps us describe the look and feel of the wood surface.

a. **Colour:** The natural colour of wood. Some are light, dark, or reddish, depending on how the wood grows.

b. **Texture:** This is how rough or smooth the wood feels, based on pore size: ***fine, medium,*** or ***coarse***.

c. **Lustre:** How the wood reflects light. It may be ***dull, moderate,*** or ***shiny (lustrous)***.

d. **Fibre length:** Shows how long and straight the wood fibres are. Long fibres usually mean stronger wood.

e. **Grain:** Describes the pattern or direction of the wood fibres: straight, wavy, or interlocked.

Physical Properties (How the wood reacts to the environment)

These describe the wood's weight and how it changes with moisture.

a. **Basic Density:** Measures how heavy wood is for its size. Heavy woods are often stronger and more durable.

b. **Movement in Service (Moisture Movement):** Wood swells when it absorbs moisture and shrinks when it dries. This affects its use in doors, furniture, or construction.

Strength Properties (How the wood handles pressure and force)

These show how strong or flexible wood is under pressure.

a. **Modulus of Elasticity (MOE):** Measures how stiff or flexible wood is when it bends.

b. **Modulus of Rupture (MOR):** Tells us how much force the wood can take before it breaks.

c. **Compression Parallel to Grain:** Shows how well the wood handles pressure along its length.

d. **Shear Parallel to Grain:** Tests how the wood resists sliding or slipping inside when pushed from both ends.

e. **Janka Side Hardness:** Measures how well the wood resists scratching or denting.

Performance Properties (How the wood lasts and takes in treatment)

a. **Durability:** Tells us how well the wood can resist attack from insects, fungi, or rot. Some woods last longer than others, even without chemicals.

b. **Treatability:** Shows how easily wood takes in preservatives during treatment with vacuum or pressure. Table 3.10.1 shows how treatability is classified.

Table 3.10.1: *Classification of Treatability*

Classification	Meaning
Permeable	Wood absorbs preservatives easily without problems.
Moderately Resistant	Wood can take in some preservatives, especially through vessels and pores.
Resistant	Wood is difficult to treat and needs more time under pressure.
Extremely Resistant	Wood takes in very little preservative, even with long treatment.

Table 3.10.2 Below shows examples of LKS and LUS, their colours, and how heavy they are.

Table 3.10.2: *Appearance and Basic Density of LKS and LUS in Ghana*

Species (LKS/ LUS)	Appearance (Colour)	Basic Density (kg/m^3)	Weight Class
Afena (LKS)	**Heartwood:** Brown or pale-brown with purple streaks **Sapwood:** Pale brown	850–1,020	Very Heavy
Watapuo (LKS)	**Heartwood:** Grey-brown or brown-orange **Sapwood:** Whitish-yellow	470	Medium
Apoma / Ananta (LKS)	**Heartwood:** Dark red with darker streaks **Sapwood:** Pink brown	910–1,000	Very Heavy

Effeu (LKS)	**Heartwood and Sapwood:** White or yellowish-white	350	Low
Wawabima (LKS)	**Heartwood:** Dark red-brown **Sapwood:** Pale red-brown	720–890	Very Heavy
Avodire (LUS)	**Heartwood and Sapwood:** Creamy-white to pale-yellow; turns golden-yellow with time	460–660	Medium
Danta / Kotibe' (LUS)	**Heartwood:** Red-brown **Sapwood:** Pale red-brown	740	Heavy
Red Oak / Kwatafompaboa (LUS)	**Heartwood:** Reddish-brown **Sapwood:** Whitish to greyish	610–720	Medium
Denya / Okan (LUS)	**Heartwood:** Yellow-brown to yellowish-red **Sapwood:** Greyish-pink	770–1,100	Heavy
Alstonia (LUS)	**Heartwood and Sapwood:** Yellowish-white	360–420	Low

Non-Timber Forest Products (NTFPs)

In Ghana, our forests give us more than just timber. They also provide many non-timber forest products (NTFPs)-these are things we get from the forest that are not wood, but are still very useful in our daily lives. Some can be eaten, some are used for medicine, and others help us make furniture, baskets, and even decorations.

Table 3.10.3 shows the three main types of NTFPs, what they mean in simple terms, and some examples you may already know or use.

Table 3.10.3: *Types and Examples of Non-Timber Forest Products (NTFPs)*

Type of NTFP	Meaning (Simple Explanation)	Examples	Pictures
Herbs	Plants used for medicine, cooking, or scent.	**1.** Prekese (for soup and healing) **2.** Neem leaves (for malaria treatment)	 Herbs

Edibles	Forest foods that are safe to eat.	**1.** Mushrooms **2.** Shea nuts **3.** Baobab fruits **4.** Snails **5.** Fresh & dried coconut **6.** Mangoes	 Fresh coconut Dried coconut Snail, edible NFTPs Mango
Non-Edibles	Forest items not eaten but used for making things.	**1.** Rattan (for baskets, chairs) **2.** Bamboo (for fences, furniture) **3.** Sweet prayers plant (for decoration) **4.** Leaves (for wrapping food like waakye)	 Rattan Sweet prayers plant Bamboo

Activity 3.10.1 Discovering Ghana's Hidden Forest Gold

Scenario: You are part of a youth innovation team invited to a rural development fair. Your challenge is to identify, explore, and creatively present how Ghana's lesser-known timber species and non-timber forest products (NTFPs) can be used to promote economic growth, environmental care, and cultural pride.

Materials Needed

- Short video/slideshow on LKS, LUS & NTFPs
- Posters or flashcards of species and products
- Worksheets with guiding questions
- Chart papers, glue, markers, pens

- Laptops/tablets/phones (if available)
- Design tools (cardboard, coloured pens, fabric scraps, etc.)
- Projector or TV (optional)
- Teacher observation checklist

Activity Guidelines

1. Organise yourself into a group of 4-6 members.
2. In your group, watch a short presentation or video showing various Ghanaian LKS, LUS, and NTFPs (e.g., Kokrodua, Dahoma, raffia, baobab oil, prekese, etc.). If possible, visit your local forest belt and identify the forest product species.
3. As you watch/visit, write down:
   - **a.** Name of the item
   - **b.** What it looks like
   - **c.** One common use
4. Use your worksheet to list at least:
   - **a.** Three Lesser-Known species;
   - **b.** Three Lesser-Used Timber Species;
   - **c.** Three Non-Timber Forest Products (NTFPs).
5. For each, find out:
   - **a.** Category of use (e.g., food, medicine, carving, skincare)
   - **b.** Two key properties (e.g., light, strong, smooth, oily)
   - **c.** Suggested real-world use
6. With your group, choose one task below.
   - **a.** Furniture Designer
     - **i.** Choose a timber like Yaya or Dahoma/species in your area
     - **ii.** Sketch a furniture item (e.g., chair, table)
     - **iii.** Explain why this wood is suitable
   - **b.** Skincare Entrepreneur
     - **i.** Pick two NTFPs (e.g., baobab oil + shea butter)
     - **ii.** Design a label for a skincare product
     - **iii.** Show benefits and target users
   - **c.** Craft Innovator
     - **i.** Choose a fibre (e.g., raffia, kenaf)
     - **ii.** Design a mat, bag, or basket

   iii. Show how and why it is eco-friendly

   d. Cultural Artisan

   i. Select a timber for carving (e.g., Kokrodua)

   ii. Sketch a stool, drum, or mask

   iii. Explain its cultural use and material strength

   e. Forest Food Chef

   i. Pick 3 edible NTFPs (e.g., bush mango, soursop)

   ii. Create a meal or drink idea

   iii. Share health benefits and a fun restaurant name

6. Use your collected materials to create a poster sketch, prototype, or design board

7. Present your creation

   a. Name, materials, and use

   b. Who benefits from the product

   c. Economic and environmental benefits

8. Answer feedback from peers.

   a. What they liked

   b. What could be improved

9. Write a short reflection in your notebook.

   a. What did you learn?

   b. Which forest material surprised me most?

   c. How can we promote its responsible use in Ghana?

Conclusion

Forests give us more than just popular wood. By learning to classify Lesser-Known Timber Species (LKS), Lesser-Used Timber Species (LUS), and Non-Timber Forest Products (NTFPs), we discover many useful materials that can support life, business, and the environment. Understanding their types, uses, and values helps us use forest resources wisely, protect overused trees, and promote sustainable development in Ghana.

EXTENDED READING

- Council for Scientific and Industrial Research (CSIR) 2016. Lesser-Known & Lesser-Used Timber Species, Ghana. Pages 10-45

REVIEW QUESTIONS

1. Kojo is helping his uncle select wood for making chairs. His uncle gives him two options: one from a Lesser-Known Timber Species (LKS) and the other from a Lesser-Used Timber Species (LUS). Kojo wants to compare their physical properties to choose the best one.

   What two physical properties should Kojo compare between the LKS and LUS to help him decide?

2. Ama is testing two types of wood, one from a Lesser-Known Timber Species (LKS) and the other from a lesser-used timber species (LUS). Her teacher asks her to check how each wood behaves when a force tries to slide its fibres along the same grain.

   a. What is the term for this test? Explain it.

   b. State the weak and strong value ranges for LKS and LUS.

3. Yaw is preparing wood from a Lesser-Known Timber Species (LKS) and a Lesser-Used Timber Species (LUS) for outdoor use. His teacher asks him to check how well these woods can absorb preservatives to protect them from damage.

   a. What is the term for this test, with an explanation?

   b. Explain two types of treatability that Yaw might observe

UNIT 11

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

A surface drainage system is a vital component of civil infrastructure that manages the safe removal of excess rainwater or runoff from streets, buildings, and open spaces. Planning the schedule of work involved in its installation ensures that every phase, from initial site evaluation to final commissioning, is carried out effectively, minimising the risk of flooding and erosion while promoting environmental sustainability.

This schedule typically begins with surveying terrain and mapping water flow patterns to inform the drainage layout. It includes designing channels, culverts, and catch basins, followed by excavation and construction activities tailored to the specific site conditions. Materials such as concrete, geotextiles, and grates are sourced and installed in line with regulatory standards. The final steps involve system testing and inspection for proper flow and durability.

A structured timeline helps coordinate teams, reduce delays, and ensure long-term functionality, making surface drainage not only practical but essential to resilient urban and

rural development.

The study of excavation in Year 2 is linked to this lesson. This is because excavation is one of the main site activities when carrying out surface drainage.

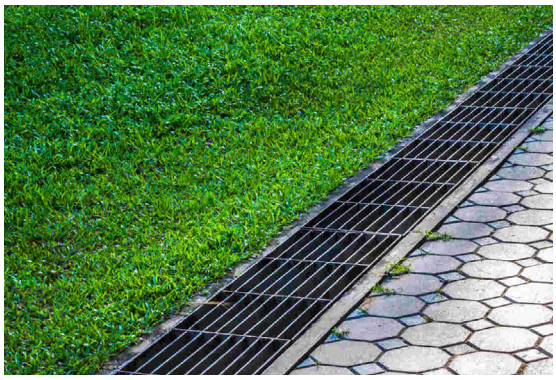
KEY IDEAS

- Backfill and compact surrounding areas to maintain structural integrity and flow efficiency.
- Begin with surveying and site preparation to assess topography and drainage needs.
- Conduct inspections and testing to confirm functionality and address any issues.
- Excavate channels or trenches according to the design layout and flow direction.
- Install drainage structures such as culverts, catch pits, and gratings.

THE SURFACE DRAINAGE SYSTEM

A surface drainage system removes excess water from the land's surface. It typically involves open ditches, channels, or graded surfaces to guide water away from an area and into a natural or constructed drainage channel. This helps prevent waterlogging and erosion and improves the overall usability and health of the land.

(A) Open surface drain system



(B) Inlet surface drainage system

Figure 3.11.1: Example of surface drainage systems

Table 3.11.1: *Surface drainage systems*

SURFACE DRAINAGE SYSTEM	DESCRIPTION
Components	1. **Open Ditches/Channels:** These are the most common components, acting as pathways for water to flow away from the area. 2. **Land Grading/Smoothing:** Modifying the land's surface to create a gentle slope towards the drainage channels, ensuring efficient water flow. 3. **Swales:** Shallow, broad channels that can be vegetated to help filter and slow down water flow. 4. **Grassed Waterways:** Areas of vegetation that allow for controlled water flow, preventing erosion.
Types of Surface Drainage Systems	1. **Ditch Systems:** Involve the excavation of ditches to collect and convey water. 2. **Humps and Hollows:** A system where parallel humps direct water into hollows, which act as shallow drains. 3. **Levees:** Embankments constructed to prevent water from flooding certain areas.

Benefits	1. **Prevents Waterlogging:** Removes excess water, preventing damage to crops and infrastructure. 2. **Reduces Erosion:** Controls water flow, minimising the risk of soil erosion. 3. **Improves Soil Conditions:** Allows for better aeration and drainage of the soil. 4. **Enhances Land Use:** Makes land more suitable for agriculture, construction, or other uses.
Purpose	Surface drainage systems are designed to manage runoff from rainfall and prevent water from accumulating on the land's surface. This is particularly important for agricultural lands, urban areas, and areas prone to flooding.

THE PRIMARY PURPOSE OF SURFACE DRAINAGE SYSTEMS

The primary purpose of a surface drainage system is to remove excess rainwater and surface runoff from an area, preventing waterlogging, soil erosion, and damage to infrastructure and property. It does this by collecting and directing the water through a network of channels, ditches, or swales, ultimately leading it away from the area to a designated outlet, such as a storm sewer or natural watercourse.

Table 3.11.2: *The primary purposes of surface drainage systems*

PRIMARY PURPOSE	DESCRIPTION
Preventing waterlogging	Surface drainage systems are crucial for areas where the soil's infiltration capacity is limited or where rainfall exceeds the soil's ability to absorb it. By effectively removing excess water from the surface, they prevent water from accumulating and causing waterlogging, which can negatively impact plant growth, soil health, and even building foundations.
Controlling soil erosion	Rapid surface runoff can carry away topsoil, leading to erosion. Surface drainage systems help manage the flow of water, reducing its velocity and minimising the potential for erosion.
Protecting infrastructure and property	Excess water can cause significant damage to buildings, roads, and other infrastructure. Surface drainage systems help to divert water away from these structures, preventing flooding, foundation problems, and other water-related damage.
Enhancing landscaping and recreation	Surface drainage can also be designed to improve the aesthetic appeal of a landscape and make it more suitable for recreational activities. For example, swales can be incorporated into the landscape design to create natural-looking water features while also providing drainage.

Supporting agriculture	In agricultural settings, surface drainage systems are essential for maintaining healthy soil conditions for crop production. They help to prevent waterlogging, which can stunt crop growth and reduce yields.

The Pre-Installation Phases of Surface Drainage Systems

The pre-installation phases of a surface drainage system involve careful planning and preparation to ensure the system functions effectively. These phases include site assessment, design, material selection, and site preparation. Thorough planning is very necessary for a successful installation of a surface drainage system. ***Table 3.11.3*** provides an outline of the pre-installation phases of surface drainage systems.

Table 3.11.3: *Outline of the Pre- Installation Phases of the Surface Drainage System*

PRE-INSTALLATION PHASES	DESCRIPTIONS
Site Assessment and Survey	1. **Identify the problem:** Determine the source and extent of the drainage problem. This involves analysing the topography, soil type, and rainfall patterns. 2. **Determine water flow paths:** Identify areas where water accumulates and the direction of water flow. This is essential for designing the drainage system to effectively manage water. 3. **Soil permeability testing:** Assess the soil's ability to absorb water. Different soil types have varying permeability, which impacts the type of drainage system needed.
System Design	1. **Choose the appropriate system:** Based on the site assessment, select the most suitable type of surface drainage system (e.g., channel drains, French drains, swales). 2. **Layout design:** Create a detailed plan of the drainage system, including the placement of channels, pipes, and outlets. 3. **Consider environmental impact:** Evaluate the potential environmental impact of the drainage system, especially if the discharge point is into a natural water body. 4. **Material selection:** Choose appropriate materials for the drainage system, considering factors like durability, cost, and environmental impact.

Material Selection	1. **Drainage channels:** Select channel drains based on their load-bearing capacity, material (e.g., plastic, concrete, metal), and suitability for the site. 2. **Pipes and fittings:** Choose pipes (e.g., PVC, HDPE) and fittings that are compatible with the chosen drainage system and the site conditions. 3. **Gravel or bedding material:** Select appropriate gravel or bedding material to provide support and drainage around the drainage channels and pipes. 4. **Outlet components:** Select appropriate outlets (e.g., connection to stormwater system, dry well).
Site Preparation	1. **Marking the area:** Accurately mark the area where the drainage system will be installed. 2. **Excavation:** Excavate trenches to the required depth and width for the drainage channels and pipes, ensuring proper slope for water flow. 3. **Base preparation:** Prepare the trench base with a layer of gravel or sand to provide a stable foundation for the drainage system. 4. **Access points:** Ensure accessible and usable access points are incorporated for inspection and maintenance throughout the drainage system.

The Key Components to Consider When Designing Surface Drainage Systems

When designing a surface drainage system, key considerations include topography, soil type, rainfall patterns, land use, and infrastructure. These factors influence the choice of drainage components like swales, ditches, and pipes, as well as the overall system design.

Table 3.11.4: *Key Components to Consider when Designing Surface Drainage System*

KEY COMPONENTS	DESCRIPTION
Topography and Slope	1. **Natural Slope:** The land's natural gradient plays a crucial role in directing water flow. Understanding the slope is essential for designing a system that efficiently channels water away from areas prone to flooding. 2. **Slope Shape:** Consider whether the slope is uniform, convex, or concave, as this affects how water moves across the surface.

Soil Type and Permeability	1. **Soil Type:** Soil composition (e.g., clay, sand, loam) determines its ability to absorb and drain water. 2. **Permeability:** A higher permeability allows for faster drainage, while lower permeability may require more elaborate drainage solutions.
Rainfall and Climate	1. **Rainfall Intensity and Frequency:** The amount and frequency of rainfall directly impact the size and capacity of the drainage system needed. 2. **Climate:** The overall climate of the area (e.g., arid, humid, temperate) should be considered when determining the system's design and materials.
Land Use and Land Cover	1. **Impervious Surfaces:** Areas with roads, buildings, and other impervious surfaces generate more runoff and require effective drainage to prevent flooding. 2. **Vegetation:** Vegetation can help slow down water flow and reduce erosion, but it's important to consider how vegetation will impact the system's design.
Drainage Components	1. **Swales:** Shallow, vegetated channels that convey stormwater runoff and promote infiltration. 2. **Ditches:** Excavated channels, often lined with stone or concrete, to carry larger volumes of water. 3. **Perforated Pipes:** Pipes with holes that allow water to enter the system and are often used for subsurface drainage. 4. **Catch Basins:** Structures that collect surface runoff and direct it into the drainage system. 5. **Culverts:** Structures that allow water to flow under roads or other obstacles.
Design Principles	1. **Rational Method:** A common method for calculating peak stormwater runoff rates. 2. **Hydraulic Calculations:** Ensuring adequate capacity of channels, pipes, and other components to handle the expected flow. 3. **Erosion Control:** Implementing measures to prevent erosion caused by flowing water, especially in areas with steep slopes. 4. **Maintenance:** Planning for regular maintenance to ensure the system functions properly over time.

Activity 3.11.1 Planning, Differentiating, and Testing: The Complete Waste Disposal Workflow

Scenario: You are a key member of a construction site plumbing team tasked with installing a waste disposal system for a multi-storey building. Your responsibility is to:

a. Help create the schedule of works.

b. Correctly identify which parts of the system deal with foul waste and which deal with surface water.

c. Compare the Pre-Installation Planning Phase with the Final Installation Phase.

d. Test the completed pipework to ensure it is safe, hygienic, and fully functional. Your individual input will shape the efficiency, safety, and environmental performance of the whole project.

Materials Needed

- Whiteboard/flip chart and markers
- Waste disposal system diagrams (showing foul waste and surface water layout)
- PVC and cast-iron pipe samples
- Wastewater and surface water labelling cards
- Measuring tape
- Sample gaskets, sealants, and pipe fittings
- Portable water for testing flow (in a practical setup)
- Field trip observation sheets

Activity Guidelines

1. Organise yourself into a group of 4-6 members.
2. On your own, write down all the steps you think are needed in a waste disposal installation schedule.
3. Share your list with your group and combine ideas into one agreed schedule.
4. As a group, respond to the guiding questions.
   - **a.** "What must happen before installation begins?"
   - **b.** "How can we make sure the system is efficient and hygienic?"
5. Using the provided diagrams, individually label foul waste and surface water pipes using the card labels.
6. Discuss with your group why the two must remain separate.

6. In your group, explain one real-world problem that could happen if they were mixed.
7. Split your group into two sub-teams
   a. Team A: Pre-Installation Planning Phase
   b. Team B: Final Installation Phase
8. Individually, list activities for your assigned phase.
9. Merge your list with your sub-team's and prepare a short explanation for the other sub-team.
10. Groups present their phase details to the class and answer questions.
11. In your group, set up a small test section of pipe. Your role:
    a. Measure and check fittings for accuracy.
    b. Help seal the ends and fill with water.
    c. Observe and record any leaks or flow problems.
12. Rotate roles so every member performs at least one test action.
13. Fill in your observation sheet with:
    a. Steps in the final agreed schedule of works.
    b. Key differences between foul waste and surface water.
    c. At least three differences between Pre- and Final phases.
    d. Step-by-step testing procedure you followed.
14. Write one personal recommendation to improve the system's efficiency or safety.
15. If possible, go on a field trip with your classmates to a construction site to observe different types of surface drainage systems. Identify the key components to consider when designing a surface drainage system. Make notes during the field trip and use these to contribute to a full class discussion on your return.

Conclusion

A clear schedule of work in waste disposal ensures proper collection, sorting, transportation, and disposal of waste. It helps maintain cleanliness, protect the environment, and promote health and safety in the community.

EXTENDED READING

- Chudley, R., & Greeno, R. (1998). Building Construction Handbook (Third Edition). A division of Reed Educational and Professional Publishing Ltd. Woburn, MA 01801-2041. Pages 65-74; 109-113.
- Hall, F., & Greeno, R. (2007). Building Services Handbook (Fourth Edition). Butterworth-

Heineman Elsevier Ltd. Oxford, U.K. Pages 323–362.

- Mike Jones et al. (2022). Building Services Engineering For Construction, Hodder Education C. O. U.K., Pages 250–270 & 300–320.

REVIEW QUESTIONS

1. Evaluate three different surface drainage approaches and recommend the most appropriate type that can be used in a wetland area.
2. Analyse the long-term benefits of a comprehensive surface drainage system.

UNIT 12

WOODWORK TECHNOLOGY

MATERIALS AND ARTEFACTS PRODUCTION IN THE WOODWORK INDUSTRY IN GHANA

Introduction

In Ghana, our forests are rich with more than just the popular timber like mahogany or odum. This unit will help you explore other valuable forest resources called *Lesser-Known Timber Species (LKS), Lesser-Used Timber Species (LUS), and Non-Timber Forest Products (NTFPs).* These include strong and beautiful woods that are not commonly used, as well as non-wood items like fruits, seeds, oils, and herbs.

Understanding and using these resources is important. It reduces the pressure on the overused trees and helps us manage our forests in a sustainable way. It also creates new job opportunities, supports local communities, and helps conserve nature for the future.

By the end of this unit, you will know how these lesser-known forest resources can benefit individuals, industries, and the environment.

Earlier in Year 3, you learned about how Lesser-Known Timber Species (LKS), Lesser-Used Timber Species (LUS), and Non-Timber Forest Products (NTFPs) are important resources from our forests and that these materials have many uses, such as building furniture, making crafts, food, and medicine.

You also learned how to identify and group these resources based on where they can be found in Ghana, how available they are, their type and what they are used for.

Knowing how to use and manage these forest products wisely helps protect our forests and creates more jobs for people in our communities

KEY IDEAS

- **Building materials:** LKS and LUS can be used for making furniture, roofing, doors, and other construction works.
- **Crafts and tools:** Some NTFPs like bamboo, rattan, and cane are used to make baskets, walking sticks, and farming tools.
- **Food products:** NTFPs such as shea nuts, baobab fruits, and mushrooms provide nutritious food and ingredients.
- **Health and medicine:** Herbs like nim leaves and prekese are used for treating

sicknesses and making herbal medicine.

- **Income generation:** Selling LKS, LUS, and NTFPs helps families and local communities to earn money.
- **Sustainable use:** Using these forest products reduces over-dependence on popular timber and helps protect the environment.

USES OF LESSER-KNOWN TIMBER SPECIES (LKS), LESSER USED TIMBER SPECIES (LUS) AND NON-TIMBER FOREST PRODUCT (NTFP)

Ghana's forests are full of valuable resources that go beyond the well-known timber species. Some tree types, like Afena and Apoma, are Lesser-Known Timber Species (LKS). Others, like Avodire and Danta, are Lesser-Used Timber Species (LUS). Even though they are not commonly used, these woods are strong, beautiful, and useful for furniture, buildings, and crafts. Using them helps reduce pressure on popular species and keeps our forests healthy.

We also get many Non-Timber Forest Products (NTFPs) from the forest. These include food like mushrooms, baobab fruits, and shea nuts, as well as useful plants like bamboo, cane, and herbs such as prekese and nim leaves. These products provide nutrition, medicine, and materials for making tools and baskets.

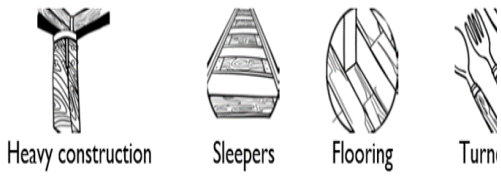
When we use LKS, LUS, and NTFPs wisely, we practice Sustainable Forest Management (SFM). This means we protect the forest, reduce waste, and support local jobs and businesses. These resources help communities make a living while keeping the forest alive for the future.

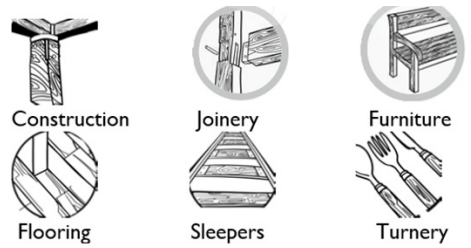
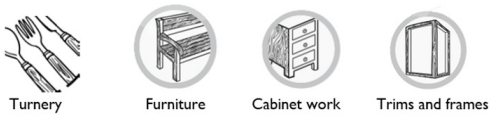
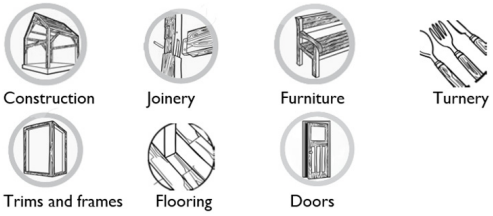
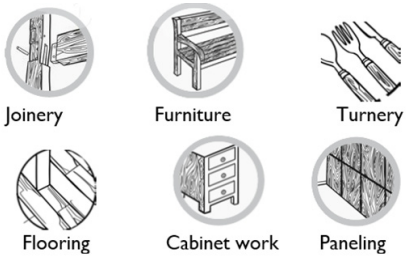
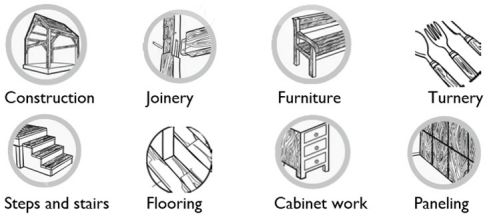
Uses of Lesser-Known Timber Species (LKS) and Lesser-Used Timber Species (LUS)

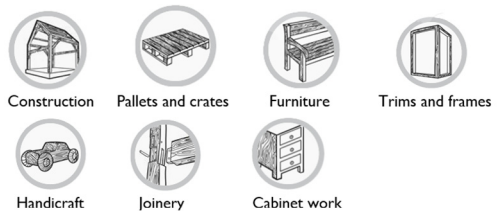
In Ghana, many timber species that are either lesser-known or less frequently used still play vital roles in construction, furniture-making, and other industries. These species offer unique properties such as durability, aesthetic appeal, and versatility, making them valuable alternatives to more commonly exploited woods.

Table 3.12.1 showcases selected species along with their typical applications. Each is accompanied by diagrams to illustrate how they are used in everyday life and industry.

Table 3.12.1: *Uses of Lesser-Known and Lesser-Used Timber Species in Ghana*

Species Name	Common Use(s)	Pictorial diagrams
1. **Afena**	**Afena** is used for interior furniture, cabinetry, and decorative panelling.	

2. Watapuo	**Watapuo is** ideal for door frames, flooring, and light construction.	
3. Apoma (Ananta)	**Apoma (Ananta) is** commonly used in carving, tool handles, and traditional crafts.	
4. Effeu	**Effeu is** suitable for veneer production and lightweight furniture.	
5. Wawabima (Brown Sterculia)	**Wawabima (Brown Sterculia) is** used in packaging, plywood, and low-cost furniture.	
6. Avodire	**Avodire is** valued for its golden hue; used in luxury furniture and musical instruments.	
7. Danta (Kotibe)	**Danta (Kotibe) is** durable and strong and used in heavy-duty flooring and railway sleepers.	
8. Red Oak (Kwatafompaboa)	**Red Oak (Kwatafompaboa) is** popular for cabinetry, interior trim, and decorative finishes.	

9. Denya (Okan)	**Denya (Okan) is** extremely hard and used in marine construction, bridges, and outdoor decking.	
10. Alstonia	**Alstonia** is lightweight and easy to work with—used in matchboxes, crates, and insulation.	

Economic Benefits Comparison of LKS and NTFPs

Forests are not only valuable for timber, but they also provide many other products that people use every day. By comparing Lesser-Known Timber Species (LKS) and Non-Timber Forest Products (NTFPs), we can better understand how each supports the economy, creates jobs, and helps protect our natural resources. ***Table 3.12.2*** shows how both can bring income and improve lives in different ways.

Table 3.12.2: *Economic Comparison: Lesser-Known Timber Species (LKS) vs. Non-Timber Forest Products (NTFPs)*

Economic Factor	Lesser-Known Timber Species (LKS)	Non-Timber Forest Products (NTFPs)
Revenue Potential	LKS can generate between ₵3,000 and ₵10,000 per cubic metre after processing and sales.	NTFPs can yield ₵500 to ₵5,000 per hectare annually, depending on the product and season.
Investment Timeline	LKS requires a long-term investment—trees may take several years or even decades to mature.	NTFPs offer short-term returns—some products can be harvested annually or even seasonally.
Capital Requirements	LKS demands significant capital for machinery, trucks, and processing equipment.	NTFPs require basic tools for collection and processing, making them less capital-intensive.
Market Development	LKS may take 2–5 years to gain market acceptance and customer demand.	NTFPs are already popular in many local markets and are sold as food, herbs, oils, or medicine.
Employment Creation	LKS creates 2–3 jobs for every 100 cubic metres of wood harvested annually.	NTFPs create 4–8 seasonal jobs per hectare, especially in rural communities.

Value Addition	LKS profits can increase 5 to 10 times through processing into furniture, flooring, and other products.	NTFPs can gain up to 500% in value when processed into oils, soaps, or herbal medicines.
Risk Profile	LKS prices tend to stabilise once the product is accepted in the market.	NTFP prices fluctuate seasonally, but product diversity helps mitigate risks.
Accessibility	LKS primarily benefits those with land rights and access to logging equipment.	NTFPs are more accessible to low-income families and women who can collect and sell forest products.

The Uses of Non-Timber Forest Products (NTFPs) in Ghana

Non-Timber Forest Products (NTFPs) are important materials we get from the forest without cutting down trees. In Ghana, these products, such as rattan, bamboo, cane, and leaves, are used for making useful items, packaging food, and supporting local businesses. They are affordable, sustainable, and provide income for many communities. ***Table 3.12.3 below shows the common uses of some NTFPs in Ghana.***

Table 3.12.3: *Uses of Non-Timber Forest Products (NTFPs) in Ghana*

NTFP	Description of Uses	Example/Visual Reference
1. Rattan	Rattan is used to make mats, baskets, fish traps, dyes, and local medicines. Internationally, it is used to make cane furniture like beds, chairs, and tables.	
2. Bamboo	Bamboo is strong and renewable. It is used to make furniture, bicycles, and many items for building and design.	Bamboo chair Bamboo bicycle

3. Cane	Cane is flexible and durable. It is used to make decorative items like baskets and is easy to clean and maintain.	Cane basket
4. Food Packaging Leaves	Leaves from plantain and pawpaw trees are used to wrap and serve local foods like waakye, rice, kenkey, tuo-zaafi, and apapransa.	Leaf for food packaging

Activity 3.12.1 Lesser-known wood species and non-timber forest products (NTFPs) Uses and Values

Scenario: You are part of a youth development team working with a rural community. Your task is to explore how lesser-known wood species and non-timber forest products (NTFPs) in Ghana can be used for economic growth and sustainability. Your team must research their uses, economic benefits, and how they can be promoted responsibly.

Materials Needed

- Video clips or slide presentations on LUS/LKS & NTFPs
- Printed posters or pictures showing various species and their uses
- Large paper sheets and markers
- Internet-enabled devices (if available)
- Printed worksheets with guiding questions
- Projector or laptop
- Notebooks, pens/pencils
- Teacher observation checklist
- Design materials (cardboard, glue, coloured pens, etc.)

Activity Guidelines

1. Organise yourself into a group of 3-5 members.
2. Copy and complete the table by listing ten of the Lesser-Known Timber Species, Lesser-Used Timber Species, and Non-Timber Forest Products from your locality.

Lesser-Known Timber Species (LKS)	Lesser-Used Timber Species (LUS)	Non-Timber Forest Products (NTFPs)

1. Create;
   - **a.** A basic product concept using one wood species and one NTFP.
   - **b.** A poster sketch or simple mock-up showing:
     - **i.** Product name
     - **ii.** Materials used
     - **iii.** Purpose and who it helps
     - **iv.** Economic benefit
     - **v.** Environmental benefit
2. Present the concepts to the class using a poster sketch or simple mock-up showing:
   - **a.** Product name
   - **b.** Materials used
   - **c.** Purpose and who it helps
   - **d.** Economic benefit
   - **e.** Environmental benefit
3. Answer questions from your peer for clarity and suggestions.
4. Write your reflection in a notebook on the following:
   - **a.** What have I learnt?

b. Which forest resource was most surprising or inspiring?

c. How can you help promote its responsible use?

Homework

Visit your local market. Can you find any items that use Non-Timber Forest Products (NTFPs)? Make a note of each product you find and share your findings to your class at the start of the next lesson.

Conclusion

You have learnt that LKS, LUS, and NTFPs are important natural resources in Ghana. They help reduce pressure on well-known timber species, support sustainable forest use, and create jobs for local communities. By using these resources wisely, we protect our forests, grow our economy, and promote eco-friendly industries like furniture making, food packaging, and herbal medicine. You must appreciate their value and support responsible use for a better future.

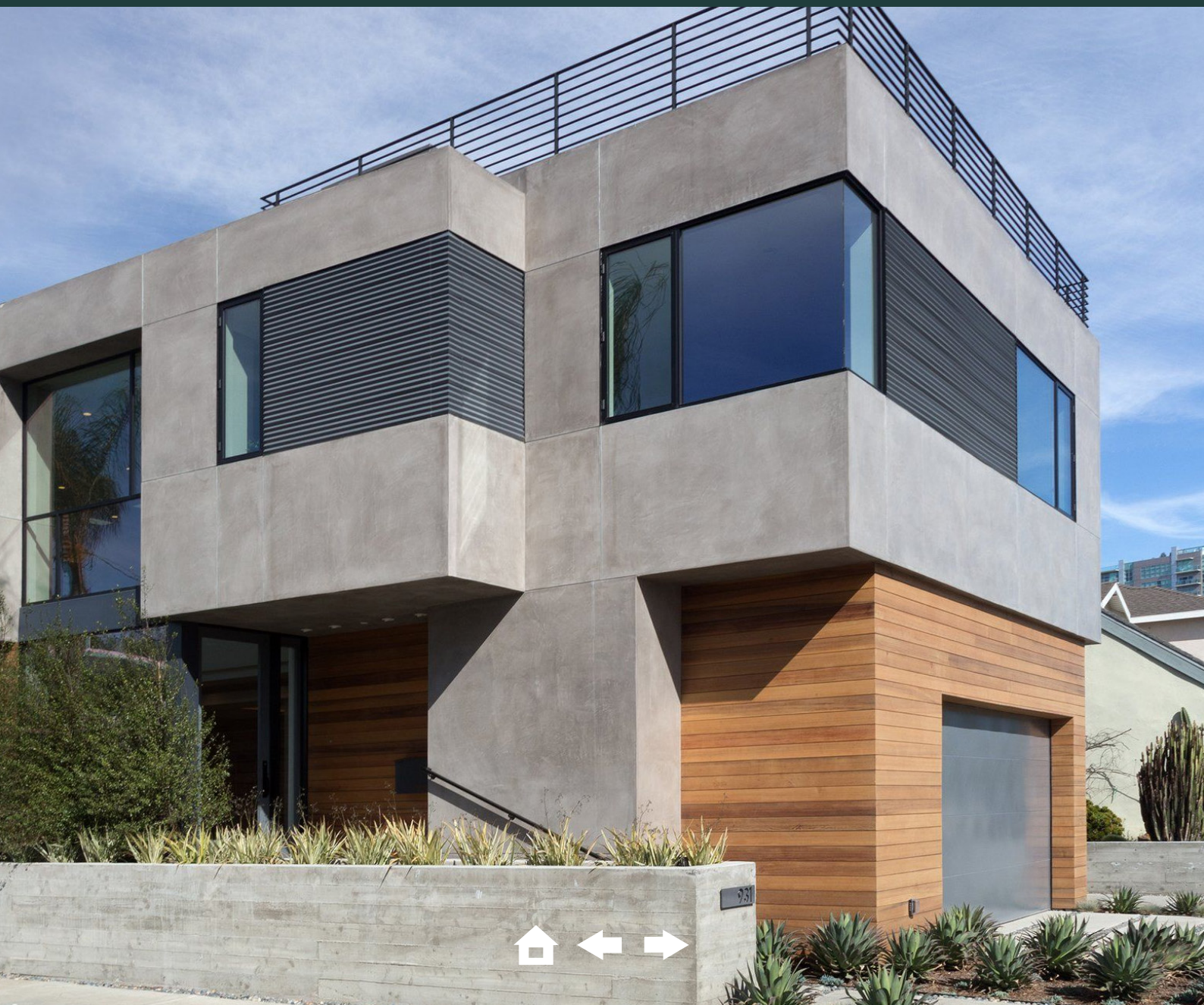
REVIEW QUESTIONS

1. Ama and Kwame are part of a school environmental club. They are discussing how to promote sustainable forest use in their community. Ama prefers using Lesser-Known Timber Species (LKS), while Kwame thinks Non-Timber Forest Products (NTFPs) are better for quick income and supporting more people. From their discussion, compare three economic benefits of using LKS and NTFPs in sustainable forest management.
2. Yaw works with a local wood company in Kumasi. He suggests that they start using more lesser-used timber species (LUS) like Dahoma and Yaya instead of always cutting popular ones like Mahogany and Odum. Some workers are unsure if this will help the timber business grow. Explain how increasing the use of LUS could affect the timber industry in Ghana.
3. Ama is a learner in a Technical School in Tamale. Her teacher asks her group to design a small table using Lesser-Known Timber Species (LKS) like Avodire, Afena, and Watapuo. Before they start, the team must sketch how these woods can be used in real-life products. Sketch three different uses of LKS in everyday items.
4. What are Lesser-Known Timber Species (LKS) used for in Ghana?
5. Give two uses of Non-Timber Forest Products (NTFPs).
6. How do LUS and LKS help promote sustainable forest use?

SECTION

4

FINISHES IN BUILDING, MASS PRODUCTION ENVIRONMENTAL IMPACT



UNIT 14

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

Finishes in building construction refer to the final touches added to a structure to improve its appearance, durability, and functionality. These elements are crucial because they give buildings their aesthetic appeal and provide protection from environmental factors. Finishes include materials and techniques used on floors, walls, ceilings, doors, and windows. They can be applied internally or externally and range from paints, tiles, and wood panels to glass, plaster, and metal cladding.

The choice of finishes depends on factors such as budget, design requirements, and the building's purpose. Good finishes enhance comfort, make maintenance easier, and contribute to the overall value of the building. In construction projects, finishes are typically applied during the final stages, once the structural and installation work is complete. Understanding finishes is essential for architects, builders, and property owners alike, as it helps ensure the space is both functional and visually pleasing

KEY IDEAS

- Common finishes include paint, tiles, plaster, and wood.
- Finishes improve a building's look and comfort.
- Good finishes increase a building's overall value.
- They protect surfaces from damage and wear.
- The right finish depends on budget and design needs.

WHAT FINISHES ARE

In construction, finishes refer to the final surface treatments applied to a building's components, both interior and exterior, to enhance its appearance, protect it from the elements, and improve its functionality. These treatments include a wide range of materials and techniques, such as painting, tiling, flooring, and trim work, applied after the structural elements are in place. Essentially, finishes are the last steps that transform a raw structure into a complete, aesthetically pleasing, and durable building.

Figure 4.13.1: Example of finish applied to a wall and floor.

Figure 4.13.2: Examples of finishes on walls

Figure 4.13.3: Finishes on walls and floors

Table 4.13.1: *Explanation of finishes*

FUNCTIONS	DESCRIPTIONS
Aesthetic Enhancement	Finishes contribute significantly to the overall look and feel of a building, allowing for customisation and personalisation of spaces.
Protection and Durability	They protect building elements from weather, moisture, wear and tear, and other environmental factors, extending the lifespan of the structure.
Functional Improvements	Finishes can improve acoustics, fire resistance, and other functional aspects of a building.
Examples	Finishes can include paint, wallpaper, tiling, flooring (like hardwood or carpet), woodwork (like trim and moulding), and various decorative elements.

Scope of Finishes	They apply to various surfaces, including floors, walls, ceilings, and even roofs.
Final Stage	Finishes are applied in the final stages of a construction project, completing the structure and preparing it for occupancy.

THE FUNCTIONS OF FINISHES IN BUILDING CONSTRUCTION

Finishes in building construction serve both protective and aesthetic functions. They shield building elements from damage and deterioration while also enhancing the visual appeal of the structure. These finishes can be applied internally or externally and contribute to the overall functionality, durability, and value of the building. ***Table 4.13.2*** provides detailed information on the functions of finishes in building construction.

Table 4.13.2: *Functions of finishes in buildings*

Functions		Description
Protective function	Protection from Weathering	Finishes like plastering, painting, and varnishing protect surfaces from rain, frost, heat, and other harsh weather conditions, preventing damage and decay.
	Protection from Impact and Abrasion	Finishes can create a durable layer that resists wear and tear from everyday use, like walking, moving furniture, or accidental impacts.
	Protection from Corrosion	Finishes can prevent rust and corrosion on metal surfaces, especially in exterior applications.
	Protection from Moisture	Finishes can help to waterproof surfaces and prevent water damage, such as from leaks or condensation.
Aesthetic Functions	Visual Appeal	Finishes enhance the appearance of buildings, creating a desired look and feel through colour, texture, and design.
	Creating Desired Ambience	Finishes can help to create a specific atmosphere or mood within a space, such as a warm and cozy living room or a sleek and modern office.
	Concealing Inferior Materials	Finishes like plaster can hide imperfections in the underlying structure and create a smooth, uniform surface.
	Adding Value	High-quality finishes can increase the overall value and marketability of a building.
	Soundproofing:	Some finishes, like certain types of plaster or wall coverings, can help to improve the soundproofing of a space.

Functional Aspects	Insulation	Finishes can contribute to the thermal insulation of a building, helping to regulate temperature and reduce energy consumption.
	Fire Resistance	Finishes like fire-resistant plaster or paint can improve the fire safety of a building.
Examples of Building Finishes	Plastering	Applying a layer of mortar to surfaces to create a smooth, even base.
	Pointing	Finishing mortar joints in brick or stone masonry.
	Painting	Coating surfaces with paint for protection and decoration.
	Varnishing	Applying a clear protective coat to wood or painted surfaces.
	White/Colour Washing	Applying a coating of lime or colour wash for decoration and protection.
	Flooring	Installing various types of flooring materials like tiles, wood, or carpet.
	Trim Work	Adding decorative and functional elements like mouldings and baseboards.
	Cabinetry and Countertops	Installing kitchen and bathroom fixtures.

BUILDING COMPONENTS THAT RECEIVE FINAL FINISHES

Building components that typically receive final finishes include walls, floors, ceilings, and roofs. Finishes can range from plastering, painting, and tiling for walls, to flooring materials like tiles, wood, or carpets for floors, and plasterboard or ceiling tiles for ceilings. The roof's final finish might involve shingles, tiles, or metal sheeting. ***Figures 4.13.4 to 4.13.6*** show examples of some types of finishes to building components.

Figure 4.13.4: Roof carcass ready for roof and final finishes applied to roof carcass.

Figure 4.13.5: Example of types of finishes applied to floors

Figure 4.13.6: Ceiling applied as a finish to the internal space under the roof

Table 4.13.3: *Various building components that receive final finishes*

COMPONENTS	DESCRIPTION
Walls	Walls are often finished with plaster, paint, wallpaper, tiles, or wood panelling.
Floors	Floor finishes can include tiles, wood flooring, carpet, vinyl, or concrete.
Ceilings	Ceilings may be finished with plaster, plasterboard, ceiling tiles, or suspended ceilings.
Roofs	Roofs can be finished with materials like tiles (clay or concrete), shingles, metal sheeting (aluminium, steel), or other specialised roofing materials.

Activity 4.13.1 Exploring Finishes in Building Construction

Scenario: Imagine you are part of a professional construction finishing team working on a new office complex. All visible surfaces, from walls and ceilings to floors and doors, must be protected, attractive, and functional before handover to the client. Your role is to personally investigate finishes, understand their

functions, identify where they are applied, and propose the most suitable ones for specific building components.

Materials Needed

- Sample boards of common finishes (paint, varnish, plaster, tiles, laminate, wallpaper, etc.)
- Photographs or printed diagrams of building interiors
- Markers and flip charts
- Measuring tape
- Notebooks and pens
- Protective gloves (for handling finish samples)
- Digital devices (optional – for online research and design)

Activity Guidelines

1. Organise yourself into a group of 4-6 members.
2. Think about what you already know about finishes from your homes, schools, or public buildings with your group.
3. As an individual, write down:
   a. Your personal definition of "finishes"
   b. Two examples you have seen in real life.
4. Bring your ideas into the group and compare them. Combine your ideas into a short group definition that you will present to the class.
5. Still working in your group, but with individual input first:
   a. List three functions of finishes (e.g., protection, aesthetics, durability, ease of cleaning).
   b. Choose one function and explain why it is important for a specific building component.
6. Combine everyone's best points into a Function and Impact Chart that links finishes to building performance.
7. Present your group chart to the class, ensuring each member contributes at least one point verbally.
8. Using the provided photographs or diagrams, you and your group members will individually mark the parts of a building that require finishes.
9. Compare your markings with those of your group mates. Identify:
   a. Which finishes suit which areas (e.g., varnish for wooden doors, tiles for wet floors)
   b. Why certain finishes are more appropriate in some spaces than others.

9. As a group, create a Building Finish Map on flip chart paper showing all components and their recommended finishes.
10. Using the samples provided, personally handle and examine the real finish samples to check:
    a. Texture
    b. Sheen
    c. Durability
11. Record your own observations in your notebook, then share your top two observations with your group.
12. Discuss as a group: "If we were finishing this office complex, which finishes would we choose and why?"
13. Take photos of at least three finishes you find in your home or community.
14. For each, write a short paragraph explaining:
    a. The material used.
    b. Its main function.
    c. Why it was probably chosen for that space.
15. Write a short note on: "One thing you have learned about finishes today that will help me make better choices in future building projects."
16. Share final insights with your class, linking back to how finishes improve both appearance and performance in real-world construction.

Conclusion

Finishes protect and beautify surfaces, making them last longer and look appealing. The choice of finish depends on the material, location, function, and style desired. Good finishes improve both durability and appearance.

REVIEW QUESTIONS

1. A building requires finishes to address infection control, durability, acoustic performance, and aesthetic appeal. Analyse how these sometimes-competing requirements affect finish selection for different areas within the facility
2. Analyse how the functions of different finishes (floors, walls, ceilings) should be prioritised in the context of a limited maintenance budget.

UNIT 14

WOODWORK TECHNOLOGY

MATERIALS AND ARTEFACTS PRODUCTION IN THE WOODWORK INDUSTRY IN GHANA

Introduction

In today's furniture industry, mass production is a key method used to make large numbers of similar products quickly and at a lower cost. This unit will introduce you to the basic techniques used in mass production, helping you to understand how items like tables, chairs, cabinets, and beds are made in factories and large workshops. Learning these techniques is important because it will prepare you for modern woodworking practices and give you the skills needed to work in industries that produce furniture on a large scale.

KEY IDEAS

- **Assembly line:** Furniture parts are put together step-by-step to increase speed and reduce labour.
- **Cutting and shaping:** Machines are used to cut wood into standard sizes and shapes for easy assembly.
- **Finishing:** Surfaces are polished, painted, or coated to improve appearance and protect the furniture.
- **Jig and fixture use:** Tools are used to hold and guide parts for accurate and repeated operations.
- **Material selection:** Durable and cost-effective materials are chosen for consistent product quality.
- **Quality control:** Each stage is checked to ensure the furniture meets set standards and is defect-free.

MASS PRODUCTION

Mass production in the woodwork industry is the process of making a large number of similar furniture items quickly and efficiently. It uses machines and standard steps to produce items like chairs, tables, and cabinets that all look the same. This method helps save time, reduce cost, and maintain good quality.

Mass production is also called flow production, repetitive flow production, series production, or serial production. It allows factories and workshops to meet high demand by producing furniture in large quantities with less waste and more accuracy. ***Figure 4.14.1 below shows how mass production is carried out in a factory.***

Figure 4.14.1: Mass production

Mass Production Facilities

Mass production facilities in the woodwork industry are special workshops or factories set up to make large numbers of furniture items quickly and efficiently. These facilities are designed to use machines and organised systems to save time, reduce cost, and produce high-quality products.

In these facilities, wood is cut into standard sizes like boards and panels to fit machines easily. Big machines such as planers, moulders, and CNC routers are used to shape and cut wood with speed and accuracy. Many tasks, like measuring and moving wood, are done automatically using sensors and conveyor belts.

Jigs and templates are also used to make sure every item is made the same way, with less time spent on setup. Materials are prepared in bulk so that many parts can be produced at once. Special cutting plans are used to reduce waste, making the process more cost-effective and eco-friendlier.

These features help mass production facilities work faster and smarter to meet the growing demand for furniture.

Mass Production Methods/Techniques in Woodwork

Mass production methods in woodwork are systems used to produce large quantities of furniture quickly, with consistent quality. These methods are used in factories to make items like chairs, tables, and cabinets more efficiently. There are three main types: Assembly line production, batch production, and cellular manufacturing.

Assembly Line Production

One major method used in woodwork mass production is Assembly Line Production. This is a system where furniture parts move through a series of workstations, with each station performing a specific task in a set order. The parts usually move in a straight-line using conveyors or rollers, and each step adds to the completion of the final product.

In this method, the work is divided into simple, repeated tasks. Each worker or machine is responsible for just one job, which makes the process faster, more organised, and less tiring. The materials move smoothly from one station to the next without interruption, reducing mistakes and improving consistency.

For example, in a factory that makes office desks, one worker cuts the parts, another drills holes, the next applies glue, then someone assembles the desk, another sands it, and finally someone applies the finish. This method helps produce many items quickly, with good quality and less effort. ***Figure 4.14.2*** shows a mass production furniture industry.

Figure 4.14.2: Mass production furniture industry

Batch Production

Batch production is a method of making furniture in groups, known as batches. In this system, one batch of items, such as chairs, goes through each stage of production (cutting, shaping, assembling, finishing) before starting the next batch, like stools.

This method is flexible and allows changes between batches, making it suitable for medium-scale production in workshops or small factories. Machines may need to be reset or adjusted when switching from one batch to another, but the process helps manage different product types while still working efficiently.

For example, a workshop may first produce 50 dining chairs. Once that batch is done, they reset the machines and begin producing 50 stools. Each batch follows the same production steps. Batch production is a useful technique for making different furniture types in moderate quantities with good quality and less waste.

Cellular Manufacturing

Cellular manufacturing is a production method where the workshop is divided into small groups called “cells.” Each cell is responsible for making a complete part or unit

of a product, such as a cabinet door or drawer. Workers in each cell perform several tasks and work together as a team to complete the process from start to finish.

This method combines the flexibility of batch production with the speed of mass production. Each cell is self-contained, meaning it has its own tools and workers to carry out the full process without relying on other parts of the workshop. It promotes teamwork, responsibility, and better communication.

For example, in a furniture factory, one cell may build complete cabinet doors by cutting, shaping, and sanding. Another cell may focus on making drawers. Each team handles a full component, which makes production faster, more organised, and results in better-quality items.

Advantages and Disadvantages of Mass Production

Mass production is a fast and efficient way of making large quantities of furniture using machines. It cuts costs, saves time, and keeps products uniform, but it also needs large startup money, can make costly design mistakes, and may lead to excess stock. Knowing these points helps learners judge when mass production is useful and when it is risky. ***Table 4.14.1*** below shows the advantages and disadvantages of mass production in a well-explained manner.

Table 4.14.1: *Advantages and disadvantages of mass production*

Advantages	Explanation	Disadvantages	Explanation
High Precision	Machines follow set instructions, so products are accurate and consistent.	High Start-up Cost	Setting up machines and assembly lines needs a lot of money.
Lower Cost	Automation reduces the number of workers needed, lowering production costs.	Design Errors Are Costly	A design mistake can cause big losses and delays.
High Efficiency	Machines make items quickly, saving time and increasing output.	Expensive Machinery	Machines are costly to buy and maintain.
Faster Distribution	Quick production helps get products to market fast, boosting profits.	Risk of Overproduction	Making too many items can lead to waste or storage problems.
Reduced Labour Costs	Fewer workers are needed, reducing wage expenses for the company.		

Applications of Mass Production in Woodwork

Mass production in woodwork means making large numbers of wooden items quickly using machines. This method helps save time, reduce cost, and keep product quality consistent. It is commonly used to produce furniture like flat-pack chairs and tables, kitchen cabinets, wooden doors, windows, flooring, wall panels, and even pallets for packaging. By using machines and automation, these products can be made faster and

in the same shape and size, which makes them easier to sell, transport, and use. Mass production has become an essential part of modern woodwork because it combines speed, quality, and efficiency.

Activity 4.14.1 Mass Production Techniques in Furniture

Scenario: You and your classmates are now junior workers in a furniture company that wants to grow fast! Your team has been selected to train other workers by showing how mass production works. You will explore three major methods of production: Assembly Line, Batch Production, and Cellular Manufacturing. Then, you will use creativity, teamwork, and research to explain how each method works, its benefits, and how it can be improved for real-world furniture making.

Materials Needed

- Video clip showing real-life woodwork mass production (shared by your teacher)
- Laptops/tablets or phones with internet (if available)
- Posters, whiteboards, markers, flashcards
- Worksheets (definitions, pros and cons, diagram sections)
- Tools or models for your mini project (depending on the method)
- Teacher's observation checklist

Activity Guidelines

1. Organise yourself into a group of 4-5 members.
2. Watch a short video showing all three methods of mass production. Write down what stood out to you.
3. In your group, pick one mass production method.
4. Research or review reference materials to explain:
   a. What the method is.
   b. One example of a wood product made using that method.
   c. Machines or tools often used for that method.
5. In your group, build a small product using the assigned method:
   a. **Assembly Line:** Each member handles one step to make multiple pen holders fast.
   b. **Batch Production:** Produce 5 identical mini stools by completing one stage at a time (cut all legs, then all tops, etc.).

   c. **Cellular Manufacturing:** Build a mini bookshelf as one team, where the same team does the full process from start to finish.

6. Create a poster or digital sketch showing:
   a. How your method works (diagram).
   b. Three advantages and three disadvantages of the method.
   c. One smart idea to improve efficiency in your method.
7. Present your findings to the class using flashcards, sticky notes, or role play.
8. Ask and answer questions from other groups. Give one positive feedback and one improvement suggestion to each group.
9. Write your thoughts on these questions.
   a. Which method would you recommend for a small furniture shop? Why?
   b. What could go wrong if the wrong method is chosen?
   c. What's one cool idea you've learnt today?
   d. Which method is best for producing chairs quickly?
   e. Would you rather choose speed or quality in production? Explain your answer.
10. With your classmates, discuss how each method affects cost, time, and quality in real-life wood factories.

Conclusion

Understanding the basic techniques in mass production helps learners know how furniture is made faster, cheaper, and in large numbers. It prepares them for modern woodwork jobs and teaches them how to use machines, follow steps, and produce quality furniture for today's market.

EXTENDED READING

- Wills H. Wagner & Clios E Kicklighter (2006). Modern woodworking tools, materials, and processes. Published by the Goodheart-Willcox Company, Inc., USA. Pages 120–145; 310–335; 600–620

REVIEW QUESTIONS

1. In a woodwork factory, chairs are being made in large numbers. The workers are placed at different points, each doing a specific task one after the other. Why is the assembly line arranged in a step-by-step (sequential) order?
2. Kwame visits two furniture workshops. One is a big factory using machines to make many chairs daily. The other is a small shop where a carpenter prepares wood by hand. How is wood preparation different in the big factory compared to the small shop?
3. Ama is learning about how furniture is made in large factories using mass production. She wants to understand the benefits and challenges of this method. What are three advantages and three disadvantages of mass production in the woodwork industry?
4. Kojo is studying how furniture is made in factories. He hears about three methods: assembly line, batch production, and cellular manufacturing. What do assembly line production, batch production, and cellular manufacturing mean in woodwork mass production?
5. What is mass production in the furniture industry?
6. Why is mass production important in woodwork?
7. What tools or methods help in mass production?

UNIUT 15

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

Floor finishes are materials or treatments applied to floor surfaces to improve their appearance, protect them from damage, and make them more functional. Common types of floor finishes include tiles, wood, vinyl, carpet, polished concrete, and stone. These finishes help create safe, durable, and attractive walking surfaces in homes, schools, offices, and other buildings.

The choice of floor finish depends on the building's use, style, budget, and maintenance needs. For example, hospitals may need smooth, easy-to-clean floors, while homes might prefer warm wood or soft carpet. Floor finishes also affect sound, comfort, and safety. Slip resistance, strength, and resistance to moisture or heavy traffic are important factors to consider.

Applying the right finish to a floor not only boosts a building's appearance but also improves its performance and longevity. A well-chosen floor finish makes spaces more welcoming, practical, and easier to care for.

KEY IDEAS

- A well-selected floor finish enhances comfort, functionality, and the overall atmosphere of a space.
- Common types include tiles, wood, vinyl, carpet, and polished concrete.
- Finishes can offer safety features like slip resistance and noise reduction.
- Floor finishes improve the appearance, durability, and cleanliness of indoor surfaces.
- The choice of finish depends on usage, style, budget, and maintenance needs.

FINISHES APPLIED TO FLOORS

Floor finishes are protective and decorative layers applied to a floor's surface. They enhance durability, appearance, and resistance to wear and tear. Choosing the right finish depends on factors like the type of substrate, intended use, and desired aesthetic. Common types include vinyl, hardwood, carpet, cork, concrete, stone, and tile. ***Table 4.15.1*** provides in detail the multiple purposes of floor finishes.

Table 4.15.1: *Multiple purposes of Floor finishes*

Purpose	Description
Protection	They shield the underlying floor from damage, such as scratches, stains, and moisture.
Aesthetics	Finishes can significantly alter the appearance of a floor, offering various colours, textures, and gloss levels.
Maintenance	Some finishes simplify cleaning and upkeep, while others require more specialised care.
Durability	They can improve a floor's resistance to heavy foot traffic, abrasion, and other forms of wear.

Table 4.15.2: *Appropriate Solutions for floors*

Solutions	Description
Vinyl	A cost-effective and water-resistant option, suitable for kitchens and bathrooms, available in various patterns.
Hardwood	A classic, durable choice that can be sanded and refinished, adding value to a space.
Carpet	Provides comfort, warmth, and noise insulation, ideal for bedrooms and living areas.
Cork	An eco-friendly, fire-resistant, and durable option, though potentially more expensive.
Tile (Ceramic/Porcelain)	Water-resistant and easy to clean, with a variety of styles and designs
Concrete	Durable and versatile, it can be stained, polished, or sealed for different looks.
Stone	Offers a natural and elegant look, requires specific cleaning and sealing.
Wood Finishes (Polyurethane/ Oil-based)	Different types of polyurethane finishes offer varying levels of gloss, durability, and drying times.

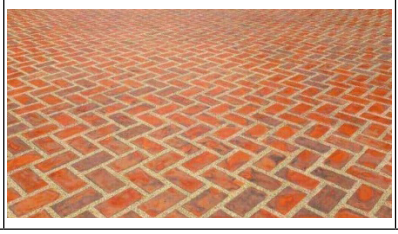
Table 4.15.3: *Factors to Consider When Choosing Floor Finishes*

Factors	Descriptions
Traffic	Areas with high foot traffic require more durable finishes.
Moisture Resistance	Bathrooms and kitchens need finishes that can withstand water exposure.
Aesthetics	Consider the desired look and feel of the space.
Maintenance	Some finishes require more frequent cleaning or specialised care.
Budget	Different finishes have varying costs associated with them.
Installation	Some finishes are easier to install than others.

THE TYPES OF FLOOR FINISHES AND THEIR FUNCTIONS

Floor finishes serve both protective and decorative purposes for a building's flooring surface. They are selected based on factors like durability, maintenance needs, aesthetics, and the intended use of the space. Common types include concrete, terrazzo, stone, wood, brick, tile, and vinyl. ***Table 4.15.4*** shows the type of floor finishes with their functions and illustrates how the various floor finishes are fixed.

Table 4.15.4: *Outline of floor finish types and their functions:*

TYPE	EXAMPLE	IMAGE	FUNCTIONS AND TYPES
Hard Floor Finishes	**A. Concrete**		• **Function:** Offers a durable and low-maintenance surface. Can be polished, stained, or stamped for aesthetic variety. • **Types:** Polished concrete, stamped concrete, stained concrete, broom finish, trowel finish, etc.
	B. Stone		• **Function:** Provides a durable, aesthetically pleasing, and relatively low-maintenance surface. Offers a natural look and can be used in various designs. • **Types:** Marble, granite, slate, limestone, sandstone, mosaic.
	C. Tile		• **Function:** Durable, water-resistant, and easy to clean. Suitable for high-moisture areas and spaces requiring frequent cleaning. • **Types:** Ceramic, porcelain, mosaic.
	D. Terrazzo		**Function**: Durable, customisable, and resistant to wear and tear. Often used in high-traffic areas.
	E. Brick		**Function:** Provides a durable, rustic appearance. Can be used for both interior and exterior spaces.

Resilient Floor Finishes	**A. Vinyl**		**Function:** Affordable, water-resistant, and easy to clean. Suitable for kitchens, bathrooms, and other areas where moisture is a concern.
	B. Linoleum		**Function**: Natural and biodegradable, offering a durable and comfortable surface. Good for areas requiring a softer, more comfortable feel.
	C. Rubber		**Function**: Provides a comfortable, slip-resistant, and durable surface. Suitable for gyms, playgrounds, and other areas needing extra safety.
Soft Floor Finishes	**A. Carpet**		**Function**: Offers comfort, warmth, and sound absorption. Ideal for bedrooms, living rooms, and other areas where sound control and a soft feel are desired.

Wood Floor Finishes:	**A. Solid Wood**		**Function**: Provides a classic and elegant look. Offers warmth, durability, and can be refinished multiple times. **Types:** Hardwood (oak, maple, etc.) and softwood (pine, fir, etc.).
	B. Engineered Wood		**Function:** More stable and less prone to warping than solid wood. Offers similar aesthetics and can be more affordable.
	C. Laminate		**Function:** Affordable and easy to install. Mimics the look of wood or other materials. Offers durability and resistance to scratches and stains.
	A. Asphalt		**Function:** Provides a durable and cost-effective surface, often used for driveways and parking areas.
	B. Glass		**Function:** Offers a unique aesthetic and can be used for decorative purposes.
	C. Bamboo		**Function:** An eco-friendly option that offers a durable and stylish surface.

TYPES OF ADHESIVES USED IN FIXING FLOOR FINISHES

Various adhesives are used for fixing floor finishes, categorised by material type and application. Common categories include epoxy, polyurethane, acrylic, and pressure-sensitive adhesives. Specific types include cement-based, mastic, and latex-modified thin-set for tile and stone, and various wood adhesives like PVA glue, epoxy, polyurethane, and contact cement. The choice depends on the flooring material, subfloor condition, and desired properties like flexibility, strength, and moisture resistance.

Table 4.15.5: *Types of Adhesives by Material*

ADHESIVE	DESCRIPTION
Epoxy Adhesives	Known for their strength and durability, making them suitable for high-traffic areas and moisture-prone environments.
Polyurethane Adhesives	Offer flexibility and strong bonding, particularly useful for hardwood, laminate, and engineered wood floors.
Acrylic Adhesives	Versatile, used for vinyl, carpet, and linoleum, offering strong bonding and resistance to moisture and temperature changes.
Pressure-Sensitive Adhesives	Commonly used for carpet tiles and some vinyl flooring, relying on pressure to create a bond.
Cement-Based Adhesives (Thinset)	Widely used for tile and stone, with variations like polymer-modified and latex-modified options.
Mastic Adhesives	Traditionally used for tile, but often replaced by more modern options.
Wood Adhesives (PVA, Epoxy, Polyurethane, Contact Cement)	Specific to wood flooring, each offering different properties for bonding and installation.

Table 4.15.6: *Choosing the Right Adhesive*

ADVESIVE	DESCRIPTION
Flooring Material	Different flooring types (tile, wood, vinyl, etc.) require specific adhesives.
Subfloor Condition	Concrete, plywood, or existing flooring impact adhesive choice.
Environmental Factors	Moisture, temperature, and traffic levels influence adhesive selection.
Desired Properties	Flexibility, strength, and cure time are important considerations.

Table 4.15.6: *Additional Considerations*

ADVESIVE	DESCRIPTION
Water-based adhesives	Environmentally friendly, easy to clean, suitable for many hardwood installations.
Solvent-based adhesives	Strong and durable, but may have strong odours and higher VOCs.
Moisture-cured adhesives	Cure in humid environments, offering good durability and moisture resistance.
Silane adhesives	Easy to use, fast drying, allow for natural wood movement.

Activity 4.15.1 Exploring Floor Finishes: Types, Functions, and Adhesives

Scenario: Imagine you are a site supervisor tasked with ensuring that all floor surfaces in a new public library building are completed with the correct flooring finishes. Your role involves selecting appropriate floor finishes, explaining their functions to workers, and ensuring the right adhesives are used for proper installation.

Materials Needed

- Samples or images of floor finishes (tiles, vinyl sheets, terrazzo, carpet swatches, wood planks, etc.)
- Adhesive samples (cement-based adhesive, epoxy adhesive, contact adhesive, etc.)
- Chart paper or whiteboard and markers
- Measuring tape
- Adhesive applicators (trowels, rollers) for demonstration
- Multimedia projector or tablet for showing videos of floor finish applications

Activity Guidelines

1. Organise yourself into a group of 4-6 members.
2. With your group, identify the unique flooring needs for the public library scenario. Consider each of the following areas.
   - **a.** Reading area
   - **b.** Computer lab
   - **c.** Children's play zone

3. You should research (using devices or provided materials) to gather information on:
   a. The functions and advantages of at least two types of floor finishes.
   b. The types of adhesives best suited for each finish.
   c. Factors that affect floor finish selection (e.g., traffic, maintenance, safety).
4. Record your findings in your notebook, ready to share with your group.
5. As a group, share and compare your individual findings.
6. Discuss these points.
   a. Which finishes best match each library space's needs.
   b. How the choice of adhesive affects durability and safety?
7. Work together to create a group recommendation sheet for the library, but ensure you personally contribute at least one finish adhesive pairing that you researched.
8. Compare your group's recommendation sheet with another group.
9. Encourage each member of your group to highlight their own contributions and explain why they believe their choice is the most suitable for its assigned space.
10. Note similarities and differences in finish selection between the two groups.
11. Using chart paper or digital design tools, create a visual mock-up of the library's floor plan with the chosen finishes.
12. You should personally design at least one section of the library in the mock-up, labelling the finish type, its function, and adhesive choice.
13. Visit a nearby building or showroom to take photos of at least two types of floor finishes.
14. Prepare a short reflection explaining your responses to these questions.
    a. Why was that finish likely chosen for that location?
    b. What adhesive might have been used and why?

Conclusion

Floor finishes protect the surface, improve appearance, and make cleaning easier. Choices such as tiles, terrazzo, wood, or carpet depend on the room's use, budget, and desired look. The right finish makes the floor durable, safe, and attractive.

EXTENDED READING

- Chudley, R., & Greeno, R. (1998). Building Construction Handbook (Third Edition).
- A division of Reed Educational and Professional Publishing Ltd. Woburn, MA 01801-2041 Pages 263-276**.**
- Schreckenback, H. (1981). Construction Technology for a Tropical Developing Country. Published in Germany, pages **170-180.**

REVIEW QUESTIONS

1. The function of floor finishes deteriorates at different rates depending on usage and maintenance practices. Analyse how the slip resistance, appearance, and wear resistance functions of three different floor finishes would change over 10 years in a school environment.
2. Analyse how the selection of floor finishes can enhance or limit a building's functional adaptability. Suggest a strategic approach for selecting floor finishes that allow for potential changes in the use of the space.

UNIT 16

WOODWORK TECHNOLOGY

MATERIALS AND ARTEFACTS PRODUCTION IN THE WOODWORK INDUSTRY IN GHANA

Introduction

The woodwork industry is a vital part of our lives, providing materials for furniture, buildings, and many useful items. However, the processes involved-such as cutting down trees, processing timber, and using chemicals-can affect the environment in both positive and negative ways. In this unit, you will explore how woodwork activities impact the natural world. You will look at the importance of using sustainable practices to reduce harm to the environment. By studying this topic, you will be better prepared to make informed decisions that support environmental protection and sustainability in Ghana and beyond.

In Year 1, you learned about the processing phases of timber in the woodwork industry, such as felling, seasoning, conversion, and finishing. These steps help turn raw trees into useful wood products. Now, we will link that knowledge to understand how each phase can impact the environment. For example, felling trees may lead to deforestation, while chemical use in finishing can pollute water and air. This unit reminds us that every timber processing phase has environmental effects, and it is important to apply sustainable methods to reduce harm.

KEY IDEAS

- Air pollution is caused when wood dust and smoke from machines enter the atmosphere.
- Deforestation happens when trees are cut down without replanting, leading to forest loss.
- Energy consumption increases due to the use of heavy machines in wood processing.
- Noise pollution is created by machines and tools used in wood workshops.
- Soil degradation occurs when wood waste is dumped carelessly on land.
- Water pollution results when chemicals and wood waste flow into rivers and streams.

THE ENVIRONMENTAL IMPACT OF THE WOODWORK INDUSTRY

The environmental impact of the woodwork industry refers to how woodworking activities affect nature, ecosystems, and human health, both positively and negatively. These impacts occur throughout the life cycle of wood products, from cutting down trees in the forest to processing, usage, and disposal.

When too many trees are harvested without replanting, it leads to deforestation. This reduces forest cover, destroys wildlife habitats, changes rainfall patterns, and increases the risk of desertification. Tree removal also exposes the soil, causing erosion, which lowers soil fertility and affects farming.

During timber processing and furniture production, machines and tools release dust, fumes, and chemicals like paints and adhesives. These pollute the air and water, harm human health, and damage the environment. Noise from machinery and high energy use also add to environmental problems.

Improper disposal of wood waste, such as sawdust and offcuts, adds to land pollution. In addition, using only well-known timber species like mahogany and Odum puts pressure on forests, making these trees scarce.

However, when managed well, the wood industry can protect the environment. Using sustainable practices like replanting trees, recycling wood waste, adopting clean technologies, and using lesser-known timber species (LKS) such as Ananta or niangon can reduce harm and keep forests healthy.

Figure 4.16.1 shows how woodwork activities affect the environment and reminds us of the need to balance wood production with environmental protection.

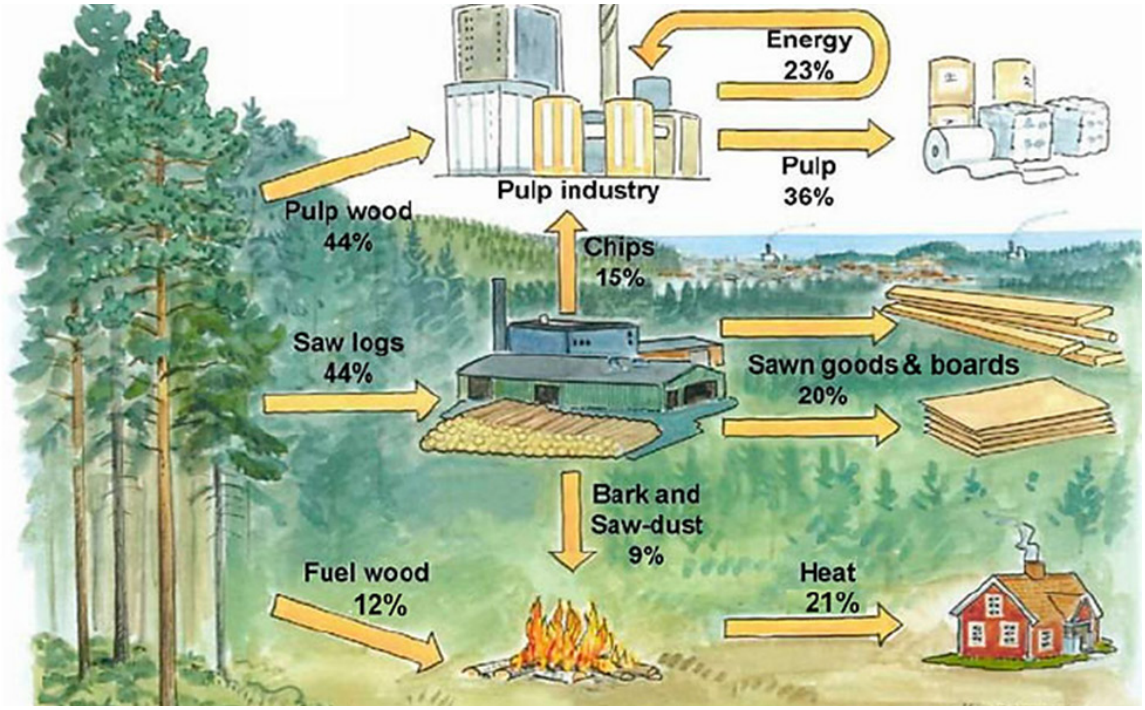


Figure 4.16.1: Impact of the woodwork industry on the environment

The woodwork industry affects the environment in both positive and negative ways. Understanding these impacts helps us find a balance between using wood for development and protecting our natural resources.

Positive Impacts of the Woodwork Industry on the Environment

Positive impacts of the woodwork industry on the environment refer to the helpful or beneficial effects that woodwork activities can have on nature when done responsibly. When the industry follows eco-friendly practices, it can support the environment instead of harming it. These benefits include those mentioned below.

1. **Use of Renewable Resources:** Wood is a renewable material when harvested from well-managed forests. If trees are replanted after cutting, forests can regenerate naturally and remain healthy for future use.
2. **Carbon Sequestration:** Wood products store carbon throughout their lifetime. This helps reduce the amount of carbon dioxide (CO_2) in the atmosphere and supports efforts to fight climate change.
3. **Recycling and Reuse:** Wood can be recycled into new materials like particleboard, mulch, or reused in construction and craftwork. This reduces waste, saves trees, and makes use of leftover wood.
4. **Promotion of Sustainable Forestry:** Many certified wood industries support responsible forest management. They replant trees and protect forest areas, helping to preserve ecosystems and maintain a long-term wood supply.

Negative Impacts of the Woodwork Industry on the Environment

The negative impacts of the woodwork industry refer to the harmful effects that wood-related activities can have on nature, people, and the climate, especially when not properly managed.

When too many trees are cut down without replanting, it leads to deforestation, which destroys forests, causes the loss of animal and plant life, and disrupts natural ecosystems. The removal of trees also exposes the land, making it prone to soil erosion, which reduces soil fertility and harms nearby farms.

Woodworking machines release dust and fumes from paints, adhesives, and chemicals used in finishing. These contribute to air pollution, affecting workers' health and nearby communities. Similarly, when chemicals like varnishes and glues are improperly disposed of, they enter rivers and streams, causing water pollution and harming aquatic life.

The industry also produces a lot of waste, such as sawdust, offcuts, and shavings, which are often dumped, leading to land pollution. In addition, the processing and transport of wood products rely on fuel, which emits greenhouse gases that cause climate change.

Finally, the health of workers is at risk due to long-term exposure to toxic substances, leading to respiratory and skin problems, while people living near factories may also face similar dangers.

Poor management of the woodwork industry can harm the environment and put human health at risk.

Sustainable Practices to Reduce Environmental Impact

Sustainable practices to reduce environmental impact mean using smart and responsible methods that protect the environment while meeting today's needs without destroying nature for future generations. In the woodwork industry, this means cutting trees carefully and replanting them, reducing waste, avoiding pollution, using eco-friendly materials, and recycling wood to protect forests.

To begin with, industries should use certified or sustainably sourced wood from forests that are well-managed. This ensures that trees are not overharvested and are replaced when cut. Also, using lesser-known timber species can reduce pressure on popular trees and protect forest diversity. Factories must apply efficient cutting techniques to reduce waste during timber processing. They should also use recycled or reclaimed wood from old furniture or buildings to avoid unnecessary tree cutting. Making manufactured boards from sawdust and wood scraps helps reduce waste, too.

To prevent air pollution, woodworking shops must install dust collection and air filtration systems. For water protection, they can use closed-loop water systems that clean and reuse water during production.

Rather than depending only on timber, the industry can also use non-timber forest products like bamboo, raffia, and coconut husk, which don't require cutting down trees. In finishing, using water-based or low-VOC adhesives and paints helps keep both workers and the environment safe.

Finally, every woodworking business should support reforestation and tree planting efforts to restore forests and ensure a greener future.

In summary, sustainable woodwork protects nature, reduces harm to the environment, and ensures that forests and wood resources remain available for future generations.

Sustainable Practices to Reduce Environmental Impact: Comparing Wooden, Plastic, and Metal Furniture

When choosing furniture, it is important to think about how the materials used affect the environment. Wood, plastic, and metal each have different environmental impacts.

Wooden furniture

Wooden furniture is made from a natural and renewable material. If the trees are harvested responsibly and replanted, wood is eco-friendly. Trees also help fight climate change by storing carbon. Wood is biodegradable, meaning it breaks down naturally without harming the environment. However, if trees are cut down without replanting, it can lead to deforestation and destroy wildlife habitats.

Plastic furniture

Plastic furniture, on the other hand, is made from petroleum, a non-renewable resource. Making plastic pollutes the air with greenhouse gases like carbon dioxide. As plastic wears out, it releases microplastics into the environment. It also doesn't last long, so people throw it away more often, and it takes hundreds of years to decompose, filling up landfills.

Metal furniture

Metal furniture is very strong and lasts a long time, which means it doesn't need to be replaced often. However, mining for metal damages land, and processing it uses a lot of energy. If metal is not recycled, it can harm the environment. But when recycled properly, metal can be reused many times, reducing waste and pollution.

In conclusion, wooden furniture is more environmentally friendly than plastic or metal, especially when the wood is sourced sustainably. It is a better choice for protecting the Earth when used wisely. ***Table 4.16.1*** gives a summary of the environmental impact of furniture materials.

Table 4.16.1: *Environmental Impact of Furniture Materials*

Material	Impact
Wooden Furniture	**1.** Wood is natural and renewable. **2.** Environmentally friendly if trees are replanted. **3.** Stores carbon and fights climate change. **4.** Biodegradable. **5.** Deforestation risk if trees are not replaced.
Plastic Furniture	**1.** Made from non-renewable petroleum. **2.** Produces greenhouse gases during manufacturing. **3.** Releases microplastics over time. **4.** Wears out quickly and needs frequent replacement. **5.** Not biodegradable; fills up landfills.

Metal Furniture	**1.** Mining damages land. **2.** Requires high energy to process. **3.** Harmful if not recycled. **4.** Recyclable many times. **5.** Durable and long-lasting.

Activity 4.16.1: Impact of the woodwork industry on the environment

Scenario: You and your squad are the "Green Minds Team", a youth-led task force invited to advise your district on what kind of furniture should be used in public places like schools, hospitals, and town halls. But here is the catch: the furniture must be eco-friendly, affordable, and long-lasting. Your mission is to uncover the environmental secrets behind the woodwork industry and make a killer recommendation based on facts, not vibes.

Materials Needed

- Short video (5–7 minutes) on the wood industry's environmental impact
- Internet-enabled devices (phones/tablets/laptops) or teacher-provided printed articles
- Large comparison chart templates (printed or digital)
- A3 manila cards, flipcharts, or brown paper
- Markers, coloured pens, sticky notes
- Reflection worksheet (teacher provided)

Activity Guidelines

1. As a class, watch a short documentary or local video with pictures showing how woodwork affects the environment.
2. On sticky notes or in your notebook, write:
   a. Something that shocked you
   b. One key environmental problem from the video
   c. One idea for reducing damage to nature
3. Pair up with someone next to you.
4. Share what you wrote.
5. Create a quick "Top three Shocks" mini list together.
6. Now team up in groups of 4–5 members.
7. Choose a team name (something fun like "Eco-Builders" or "Sustain Squad").

8. Use your devices or printed resources to explore:
   a. Two Positive effects of woodwork (e.g., sustainable forestry, natural look)
   b. Two Negative effects (e.g., deforestation, sawdust pollution)
9. Summarise on a flip chart/poster with:
   a. Eye-catching title
   b. Visuals (draw, print, or cut and paste)
   c. Quotes/statistics
10. Use the provided template to compare:

Material	Environmental Impact	Cost	Durability	Recyclability
Wood				
Plastic				
Metal				

11. In your team, discuss these questions.
    a. Which material wins for eco-friendliness?
    b. What is the best balance of cost, sustainability, and strength?
12. Write your team's conclusion in 3–5 sentences on your comparison sheet.
13. On an A3 sheet or flipchart, design a mini proposal with your team:
    a. Recommended material
    b. Environmental and health benefits
    c. Expected lifespan
    d. How it helps Ghana's sustainability goals
14. In your team, present your proposal in 2–3 minutes.
15. Complete your personal worksheet by answering these questions.
    a. What did I learn about the link between furniture and the environment?
    b. What would I tell a local carpenter about making better choices?
    c. What is one thing I will personally do to reduce waste or protect trees?

Conclusion

The woodwork industry plays an important role in Ghana's development, but it also affects the environment. Cutting trees, using chemicals, and producing waste can lead to deforestation, pollution, and soil erosion. It is important to understand the impacts and promote sustainable practices like using lesser-known timber species, recycling

waste, and replanting trees. This will help protect the environment while keeping the woodwork industry strong and beneficial for future generations.

EXTENDED READING

- Reid Hannah et al. (2004). Using wood products to mitigate climate change. The Edinburgh centre for carbon management. Scotland. Pages 13–20; 22–32; 33–45
- Wills H. Wagner & Clios E Kicklighter (2006). Modern woodworking tools, materials, and processes. Published by the Goodheart-Willcox Company, Inc., USA. Pages 5–15; 600–620

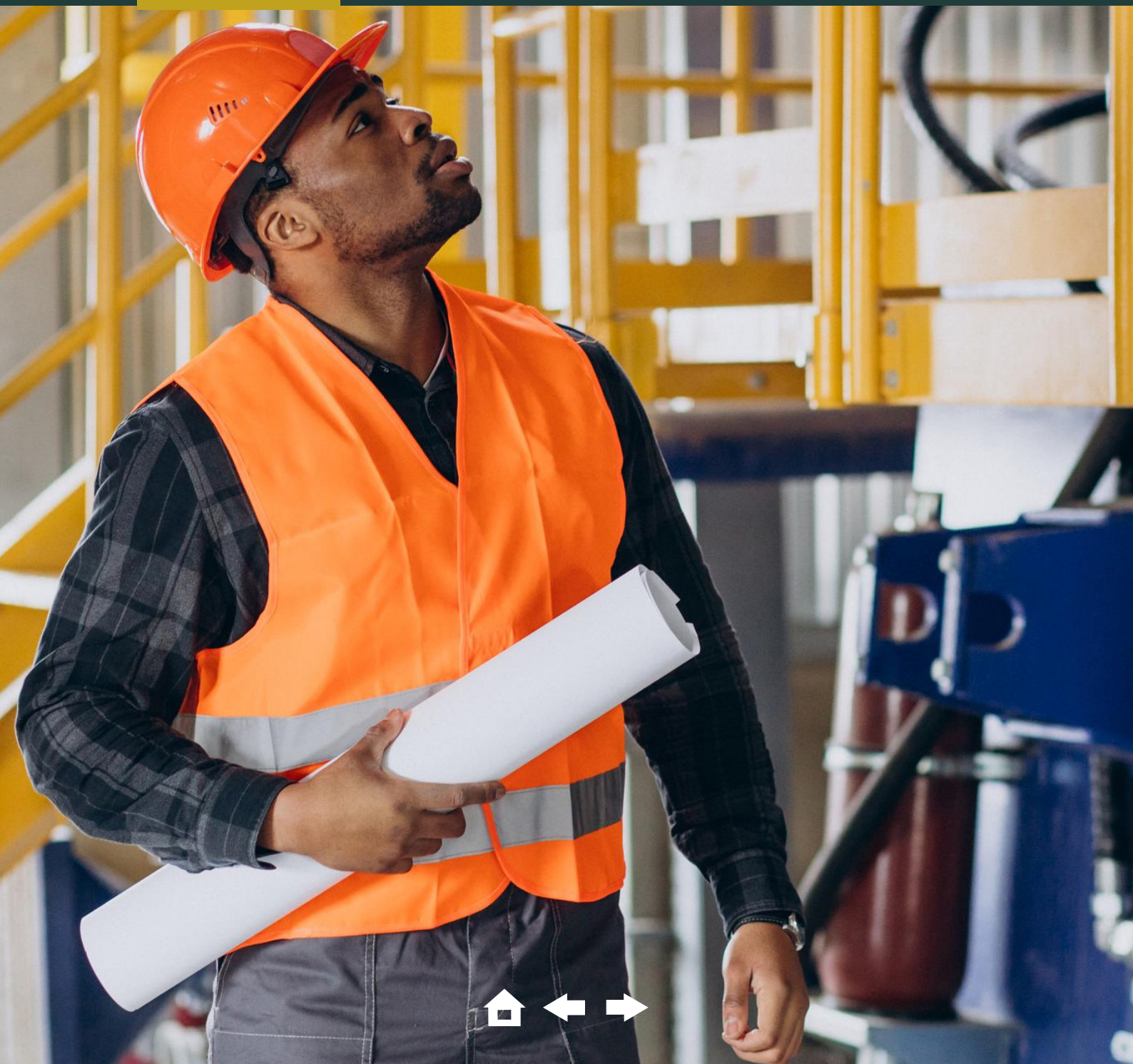
REVIEW QUESTIONS

1. Most woodworkers in Ghana use popular timbers like mahogany and odum, but these trees are becoming scarce. How can using Lesser-Known Timber Species (LKS) like Ananta, Esa, or niangon help reduce environmental damage while keeping the woodwork industry profitable?
2. Kwabena is researching the negative environmental impacts of the woodwork industry in Ghana. Analyse two major ways this industry can harm the environment.
3. Adjoa is comparing wooden, plastic, and metal furniture to understand their impact on the environment. Explain one environmental impact for each type of furniture.

SECTION

5

FINISHES IN BUILDING AND ENTREPRENEURSHIP



UNIT 17

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

Wall finishes are materials or treatments applied to wall surfaces to improve how they look, last, and perform. They help protect walls from damage, make spaces more attractive, and support cleanliness and comfort. Common wall finishes include paint, plaster, tiles, wallpaper, wood panels, and metal sheets. Each type offers a different feel, texture, and function.

In homes, wall finishes can create warm or bright spaces. In schools and hospitals, they must be easy to clean and resistant to wear. Offices often use finishes that reduce noise and add style. The choice depends on how the space is used, the budget, and how much maintenance is expected.

Wall finishes also affect safety and hygiene. Smooth surfaces stop dirt from building up. Some finishes help control sound or resist fire. Selecting the right wall finish makes buildings safer, nicer to live and work in, and easier to take care of.

KEY IDEAS

- Wall finishes improve how rooms look and feel.
- They protect walls from stains, moisture, and damage.
- Common wall finishes include paint, tiles, plaster, and wood panels.
- The right choice depends on cleanliness needs, design style, and budget.
- Good wall finishes can reduce noise and make spaces easier to maintain.

FINISHES APPLIED TO THE WALL SURFACE AND THEIR FUNCTIONS

Wall finishes are surface treatments applied to walls, serving both aesthetic and functional purposes. They enhance a space's appearance, protect the underlying structure, and can even provide soundproofing or insulation. A wide array of finishes exists, including paints, wallpapers, textured coatings, panelling and more, each offering

unique characteristics and benefits. ***Table 5.17.1 describes the many functions of wall finishes and their descriptions.***

Table 5.17.1: *Functions of Wall Finishes*

FUNCTION	DESCRIPTION
Aesthetic Enhancement	Wall finishes add colour, texture, and pattern to a room, transforming plain walls into focal points and setting the tone for the entire space.
Protection	They act as a barrier against moisture, impact, and abrasion, safeguarding the wall structure and prolonging its lifespan.
Soundproofing	Some finishes, like certain textured coatings or fabric-covered panels, can improve a room's acoustics by absorbing sound and reducing noise levels.
Insulation	Certain finishes, like thicker panelling or specialised coatings, can provide a degree of thermal insulation, helping to regulate temperature and reduce energy consumption.
Concealment	Wall finishes can effectively hide imperfections, wiring, and other structural elements, creating a clean and polished appearance.

TYPES OF FINISHES APPLIED TO WALL SURFACES

Plaster as a Wall Finish

Plaster is a smooth, durable wall finish made from materials like gypsum, lime, or cement. It provides a clean surface for painting or decoration and helps protect walls from moisture and wear. Plaster can be applied to both interior and exterior walls.

Method of Applying Plaster

1. Surface Preparation
   - **a.** Clean the wall of dust, grease, or loose particles.
   - **b.** Wet the surface slightly to improve adhesion.
   - **c.** Apply a bonding agent if needed.
2. Applying the Base Coat (Scratch Coat)
   - **a.** Mix plaster to a workable consistency.
   - **b.** Apply the first layer (about 10–15 mm thick) using a trowel.
   - **c.** Scratch the surface lightly to create a key for the next coat.
   - **d.** Allow it to cure for 24–48 hours.
3. Applying the Finish Coat

   a. Apply a thinner layer (3–5 mm) of fine plaster.
   b. Smooth it out with a trowel for a polished finish.
   c. Let it dry completely before painting or decorating.

Paint as a Wall Finish

Paint is a popular wall finish that adds colour, texture, and protection to interior and exterior surfaces. It enhances aesthetics, resists moisture, and can be easily cleaned or updated. Common types include emulsion (for interiors), enamel (for durability), and textured paints (for decorative effects).

Method of Applying Paint

1. Surface Preparation
   a. Clean the wall to remove dust, grease, or old flaking paint.
   b. Fill cracks or holes with putty and sand smooth.
   c. Apply a primer to seal the surface and improve paint adhesion.
2. Mixing and Choosing Paint
   a. Stir the paint thoroughly.
   b. Choose appropriate tools: brushes, rollers, or sprayers.
3. Applying the Paint
   a. Apply the first coat evenly using the chosen tool.
   b. Allow it to dry (usually 4–6 hours).
   c. Apply a second coat for full coverage and a smooth finish.

Tiles as a Wall Finish

Tiles are durable, water-resistant wall finishes commonly used in kitchens, bathrooms, and other moisture-prone areas. They come in various materials like ceramic, porcelain, glass, and natural stone, offering both functional and decorative appeal.

Method of Applying Tiles

1. Surface Preparation
   a. Clean and level the wall surface.
   b. Apply a waterproof membrane if needed (especially in wet areas).
2. Marking and Layout
   a. Measure and mark guidelines to ensure straight rows.
   b. Plan tile placement to minimise cuts and waste.
3. Applying Adhesive

   a. Spread tile adhesive (thin-set mortar) evenly using a notched trowel.
   b. Work in small sections to prevent drying before tile placement.
4. Fixing the Tiles
   a. Press tiles firmly into the adhesive.
   b. Use spacers to maintain even gaps between tiles.
5. Grouting
   a. After the adhesive sets (usually 24 hours), fill gaps with grout.
   b. Wipe off excess grout and polish tiles once dry.

Wallpaper as a Wall Finish

Wallpaper is a decorative wall finish made from paper, vinyl, or fabric. It comes in various colours, patterns, and textures, offering a quick way to enhance interior aesthetics. It's ideal for feature walls or entire rooms and can be easily replaced or updated.

Method of Applying Wallpaper

1. Surface Preparation
   a. Clean and smooth the wall surface.
   b. Fill holes or cracks and apply a primer if needed.
2. Measuring and Cutting
   a. Measure wall height and cut wallpaper strips accordingly.
   b. Match patterns if using printed designs.
3. Applying Adhesive
   a. Apply wallpaper paste to the back of the paper or directly on the wall (depending on type).
   b. Let it sit briefly if required by the manufacturer.
4. Fixing the Wallpaper
   a. Align and press the wallpaper onto the wall from top to bottom.
   b. Smooth out air bubbles with a brush or roller.
   c. Trim excess at edges and corners.

Cladding as a Wall Finish

Cladding is a protective and decorative layer applied to the exterior or interior walls of a building. It can be made from materials like wood, stone, metal, vinyl, or composite panels. Cladding enhances aesthetics, improves insulation, and protects walls from weathering and damage.

Method of Applying Cladding

1. **Surface Preparation**
   - **a.** Inspect and clean the wall surface.
   - **b.** Install a moisture barrier or insulation layer if required.
2. **Framework Installation**
   - **a.** Fix a supporting framework (usually timber or metal battens) to the wall.
   - **b.** Ensure the frame is level and securely anchored.
3. **Cladding Attachment**
   - **a.** Attach cladding panels or boards to the framework using screws, nails, or clips.
   - **b.** Maintain proper spacing for expansion and ventilation.
4. **Finishing Touches**
   - **a.** Seal joints and edges to prevent moisture ingress.
   - **b.** Apply trims or corner pieces for a polished look.

TYPES OF ADHESIVES USED FOR WALL FINISHES

For walls and finishes, a variety of adhesives are used, including epoxy, polyurethane, acrylic, and cement-based options, each suited for different applications and materials. Epoxy adhesives are known for their strength and resistance to moisture, making them suitable for tiles and other finishes. Polyurethane adhesives offer flexibility and are often used for woodworking and in areas prone to movement. Acrylic adhesives provide strong, fast-drying bonds for various materials. Cement-based adhesives are versatile and commonly used for tiling, offering both strength and affordability. ***Table 5.17.2*** provides details of the types of adhesives used for wall finishes. The descriptions will enable you to understand fully the strengths, applications and examples of the various adhesives.

Table 5.17.2: *Types of adhesives used for wall finishes*

ADHESIVES		DESCRIPTION
Epoxy Adhesives	Strengths	Very strong, moisture-resistant, and can withstand high temperatures.
	Applications	Ideal for bonding tiles, especially in bathrooms and kitchens, as well as for structural applications.
	Examples	Marine epoxy is a strong, waterproof option for areas submerged in water.

Polyurethane Adhesives	Strengths	Flexible, strong, and resistant to moisture and temperature changes.
	Applications	Good for woodworking, bonding materials that may expand or contract, and for outdoor applications.
	Examples	Can be used for various construction projects, including bonding drywall and other wall finishes.
Acrylic Adhesives	Strengths	Strong, fast-drying, and can provide a clean finish.
	Applications	Suitable for a wide range of materials, including lightweight insulation and various wall finishes.
	Examples	Often used for bonding panels, trims, and other decorative elements.
Cement-Based Adhesives	Strengths	Versatile, strong, and relatively inexpensive.
	Applications	Primarily used for tiling, including ceramic, porcelain, and natural stone.
	Examples	Standard cement-based adhesives are suitable for general tiling, while flexible options can accommodate movement and expansion.
Other Adhesives	Silicone Adhesives	Waterproof, flexible, and resistant to UV rays, making them suitable for sealing windows, doors, and joints, particularly in bathrooms and kitchens.
	Hot Melt Adhesives	Quick-setting adhesives are used in various applications, including DIY projects and larger construction tasks.
	Contact Cement	Provides a strong, permanent bond by applying adhesive to both surfaces before pressing them together.

Activity 5.17.1 Exploring Wall Finishes in Construction

Scenario: Imagine you are part of a professional interior design team renovating a modern office building. Your role in the group is to personally research and recommend the best wall finishes for one specific area of the building, such as the reception, conference room, or hallway. While working in your group, you must take responsibility for your own section, ensuring your recommendations are durable, attractive, and appropriate for the style and purpose of the space. You will explore the functions of wall finishes, types available, best application methods, and most suitable adhesives.

Materials Needed

- Pictures or samples of wall finishes (painted, wallpapered, tiled, panelled, textured plaster, etc.)
- Chart paper or whiteboard

- Markers and pens
- Adhesive samples (cement-based, glue-based, etc.)
- Short video clips on wall finishing techniques
- Notebook for personal notes and sketches
- Safety gear for site visit (helmet, reflective vest, boots)

Activity Guidelines

1. Organise yourself into a group of 3-4 members.
2. Watch a short video on wall finishing processes.
3. In your group, share prior knowledge about wall finishes.
4. Each member of your group now selects one building space to focus on for the rest of the activity.
5. As a group, discuss:
   a. Functions of wall finishes.
   b. Types of finishes applied to walls.
   c. Methods of applying these finishes.
   d. Types of adhesives used.
6. Take individual notes for your selected building space.
7. Present your overall findings as a group.
8. When presenting your findings, each member explains their own section and chosen finish.
9. Visit a nearby construction site.
10. Observe wall finishes in spaces similar to your assigned area.
11. Take photographs or sketch details, note the application methods, and record the adhesives used.
12. Participate in a question-and-answer session with construction workers or the site supervisor.
13. Write a reflection explaining the following.
    a. The finish you would choose for your assigned area.
    b. Why it is the most suitable in terms of aesthetics, durability, cost, and maintenance.
14. Come together with your group members to summarise your reflections into one team recommendation.

Conclusion

Wall finishes protect surfaces, improve beauty, and make spaces more comfortable. The choice depends on the purpose of the room, cost, and desired style. Options like paint, wallpaper, tiles, or panelling each give different looks and functions. Using the right finish makes walls durable, attractive, and easy to maintain.

EXTENDED READING

- Chudley, R., & Greeno, R. (1998). Building Construction Handbook (Third Edition). A division of Reed Educational and Professional Publishing Ltd. Woburn, MA 01801-2041 Pages 277-288.
- Schreckenback, H. (1981). Construction Technology for a Tropical Developing Country. Published in Germany, Pages 181-190.

REVIEW QUESTIONS

1. Modern building design requires finishes to serve multiple functions. Analyse how wall finishes could be selected to integrate protective, aesthetic and durability functions in an office environment.
2. Different adhesives deteriorate at different rates depending on environmental conditions and the materials they're bonding. Analyse how the bond strength of three different wall finish adhesives would change over time in spaces with varying weather conditions.

UNIT 18

WOODWORK TECHNOLOGY

MATERIALS AND ARTEFACTS PRODUCTION IN THE WOODWORK INDUSTRY IN GHANA

Introduction

This unit introduces you to entrepreneurship in the woodwork industry. It focuses on how to identify business opportunities, create wood-based products or services, and manage a small woodwork business to meet customer needs. As the demand for custom furniture, home fittings, and wooden décor increases, skilled individuals can turn their passion for woodwork into a profitable venture. You will explore how to plan, produce, price, and promote woodwork products successfully in a competitive local market. This unit is important because it equips you with practical business skills and encourages self-employment, creativity, and economic growth in Ghana.

KEY IDEAS

- Business planning helps set clear goals and steps for running a successful woodwork business.
- Customer needs **must be understood to create products that people want to buy.**
- Innovation allows woodworkers to design unique and attractive products for the market.
- Marketing involves promoting woodwork products to attract and keep customers.
- Pricing must cover costs and still be affordable to stay competitive.
- Profit-making is the goal of entrepreneurship and helps grow the woodwork business.

ENTREPRENEURSHIP

Entrepreneurship means seeing a business opportunity and taking steps to turn it into a real product, service, or business. It is about using your skills, ideas, and resources to create something valuable that helps people and society. Entrepreneurs are not afraid to take risks, try new things, and solve problems.

An entrepreneur is someone who starts and runs a business. Some people may see the entrepreneur as a competitor, but others may see them as a partner, supplier,

or customer. Entrepreneurs create jobs, reduce waste, and find smarter ways to use resources. They help the economy grow and make life better for many people.

Entrepreneurship in the Woodwork Industry

In the woodwork industry, entrepreneurship means finding business ideas and turning them into money-making activities. This can include making and selling wooden furniture, cabinets, carvings, and other items. To do well, one needs hands-on skills in woodwork, smart business thinking, and creative ideas. Entrepreneurship in woodwork helps reduce unemployment and brings more locally made products into the market. ***Figure 5.18.1*** shows an example of entrepreneurship in the woodwork industry.

Figure 5.18.1: Entrepreneurship in the woodwork industry

Areas of Basic Entrepreneurship in the Woodwork Industry

In the woodwork industry, entrepreneurship is more than just making products; it involves a range of activities that help a business grow and succeed. One important area is identifying business opportunities. A smart entrepreneur looks for what people need, such as furniture, doors, or wooden crafts, and finds ways to solve problems customers face, like designing stronger chairs or more attractive tables.

Another key area is product design and development. This involves creating wooden items that are not only attractive but also strong and useful. Entrepreneurs often make custom products based on the specific needs and preferences of their customers, such as a uniquely designed bed or table.

Production and quality control also play a big role. Entrepreneurs must use the right tools and machines to produce high-quality items. They also make sure the workshop is safe and that materials are used wisely with little waste.

Marketing and sales are essential for business growth. Entrepreneurs promote their products through social media, posters, and local events. Building good relationships with customers and delivering orders on time help maintain trust and loyalty.

Financial management is another important area. Successful entrepreneurs set fair prices that cover their costs and bring profit. They also keep proper records of spending, earnings, and profits to manage their business well.

Customer service cannot be ignored. Entrepreneurs should listen to feedback and improve their products or services. They may also offer after-sales services like repairs or replacements when needed.

Lastly, legal and safety requirements must be followed. Entrepreneurs may need to register their business, depending on the law, and must always use protective equipment like gloves and goggles to stay safe while working.

Building skills in these areas empowers young entrepreneurs in Ghana to thrive in woodwork and boost local job creation.

Importance of Entrepreneurship in Woodwork

Entrepreneurship in woodwork plays a big role in Ghana's growth and development. It creates jobs and income, as people who start woodwork businesses are able to employ themselves and others, helping to reduce unemployment and support families financially. It also promotes local craftsmanship by encouraging the use of traditional skills and talents to produce beautiful and useful wooden products, helping to preserve our cultural heritage.

Another benefit is that it reduces the import of furniture and wood products. When we make these items locally, we rely less on foreign goods, which saves the country money and boosts the local economy. Finally, entrepreneurship in woodwork encourages innovation and self-employment. It inspires people to think creatively, find better ways of doing things, and become their own bosses, paving the way for a brighter and more independent future.

Factors that Make a Woodwork Business Successful

A successful woodwork business depends on several important factors. First, the quality of products is key. Customers are drawn to strong, well-finished wooden items that last long. Using good-quality wood and strong joints builds trust, while careful attention to design, sanding, and finishing helps the product stand out in the market.

Meeting local needs is also important. Products should match the tastes, lifestyle, and income levels of people in the community. Making useful items like chairs, doors, shelves, and kitchen stools keeps demand steady.

Affordable pricing is another factor. The prices must be reasonable for local customers while still offering value for money. This builds loyalty and support from the community.

Skilled labour makes a big difference too. Trained workers help maintain high quality, speed up production, and reduce waste. A strong team leads to better products and satisfied customers.

Effective marketing helps the business grow. Using word-of-mouth, posters, radio ads, and social media can attract new customers. Displaying finished products at local events or exhibitions also increases visibility.

A steady supply of materials is also needed. Regular access to wood, glue, nails, and other items prevents delays. Building good relationships with local suppliers can also help cut down costs.

Lastly, innovation and variety keep the business fresh. Offering new designs like foldable furniture or carved signs can attract attention. Mixing both traditional and modern styles gives customers more options and keeps the business competitive.

Challenges of Starting Up a Woodwork Business

Starting a woodwork business can be exciting, but it also comes with several challenges, especially for beginners. One major challenge is limited start-up capital. Many new entrepreneurs do not have enough money to buy machines, rent a proper workshop, or purchase quality materials in large quantities. This can make it hard to start strong.

Another issue is the lack of business knowledge. While some woodworkers are very skilled with their hands, they may not know how to set prices, market their products, or keep proper business records. Without these skills, it is difficult to run a successful business.

Inconsistent supply of materials is also a common problem. If there is no steady access to good-quality timber, glue, and other items, production can be delayed or completely stopped.

Attracting customers can be difficult for new businesses. It takes time to build trust and get noticed, especially when there are already many businesses offering similar products.

A lack of workshop space adds to the struggle. Some beginners do not have a dedicated or well-equipped area to work, which affects their productivity and the quality of their work.

Competition from bigger and more established businesses can also discourage new woodworkers. These older businesses may already have loyal customers and better resources, making it hard for newcomers to grow.

Lastly, some beginners may lack confidence and experience. They might fear failure or doubt their abilities, which can stop them from taking bold steps or pushing their business forward.

Despite these challenges, with determination, learning, and support, a small woodwork business can grow into a strong and successful enterprise.

Activity 5.18.1 Becoming an Entrepreneur in the Woodwork Industry

Scenario: You just finished your carpentry training and are ready to start a small woodwork business. But before building furniture, you need to build your entrepreneurial mindset. Discover how other woodworkers did it and design a small business of your own.

Materials Needed

- Short video on entrepreneurship in the woodwork industry
- Flip charts or manila cards
- Brainstorming worksheets
- Sample business plan template (digital/printed)
- Markers and pens
- Laptops/tablets (if available)
- Poster

Activity Guidelines

1. Organise yourself into a group of 4-6 members.
2. Watch a short local or online video about a Ghanaian woodwork entrepreneur. In your own words, write what entrepreneurship means to you.
3. In your group, discuss the following questions.
   a. What inspired the entrepreneur?
   b. What challenges did they face?
   c. What made them succeed?
4. With your group, investigate a key woodwork niche (e.g., furniture, décor, carvings, repairs). Write down:
   a. What the business does.
   b. Who it serves.
   c. Skills or tools needed.
5. On a flipchart or digital slide, outline your group's woodwork business idea. Remember to include:
   a. Name and logo
   b. Target customers
   c. Services
   d. Key tools and startup costs
6. List three success factors for a woodwork business. Explain how to apply these to your own plan.
7. Turn your idea into a poster.
8. Present your group's business idea to the class in 2–3 minutes.
9. Listen to other groups and give feedback. Is the idea clear? Realistic? Creative?
10. Write what you have learned about entrepreneurship.

11. Post your business idea on a class blog, board, or exhibit for others to see.

Conclusion

Basic entrepreneurship in the woodwork industry teaches you how to turn woodwork skills into a successful business. By understanding customer needs, planning well, setting fair prices, and promoting their products, young entrepreneurs can create jobs and earn income. This knowledge can help you to become creative, self-reliant, and ready to grow a small business that supports your community and the nation's economy.

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- Jonathan T Scott (2017). The Entrepreneur's Guide to Building a Successful Business. Oxford University Press, UK. Pages 11–70
- Wills H. Wagner & Clios E Kicklighter (2006). Modern woodworking tools, materials, and processes. Published by the Goodheart-Willcox Company, Inc., USA. Pages 600–620

REVIEW QUESTIONS

1. Yaw has opened a small woodwork shop in his local town. Explain three key factors that can help make his woodwork business successful in the community.
2. Ama wants to start a furniture-making business in her community. Analyse four key challenges she might face as a beginner in the woodwork industry.
3. Akua runs a woodwork shop, but many customers complain that her furniture breaks easily or looks unfinished. Explain how the poor quality of her products can affect customer satisfaction and the long-term success of her business.
4. What is entrepreneurship in the woodwork industry?
5. Why is it important to understand customer needs in a woodwork business?
6. How can a woodworker promote their products in a local market?

UNIT 19

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

Roof carcass finishes to protect it and improve performance. These finishes help prevent water penetration, reduce heat gain, and increase are treatments or coverings added to the structural framework of a roof the roof's lifespan. Common materials include metal sheets, tiles, shingles, waterproof membranes, and thermal insulation layers. Each type offers different advantages depending on climate, building use, and cost.

In hot and rainy regions like Kumasi, finishes must resist moisture and help with cooling. Proper roof finishes also improve energy efficiency and contribute to the overall comfort of indoor spaces. Besides performance, finishes affect the roof's look and how well it blends with the rest of the building.

Choosing the right finish for a roof carcass means considering durability, maintenance, cost, and environmental conditions. It's an essential step in construction that protects the building and makes it safer and more pleasant for users.

KEY IDEAS

- Finishes protect the roof structure from water, heat, and weather damage.
- They include materials like tiles, sheets, shingles, and waterproof layers.
- The right finish helps make buildings cooler, drier, and more comfortable.
- Finishes also improve the appearance and durability of the roof.
- Choosing suitable finishes depends on climate, cost, and building type.

FINISHES APPLIED TO THE ROOF

Roof finishes can be broadly categorised into those for pitched roofs and those for flat roofs, with variations in materials like asphalt, metal, tiles, and green roofs, each offering unique benefits in terms of cost, durability, and aesthetics. Flat roofs often utilise materials like bitumen, GRP (glass reinforced plastic), and single-ply membranes, with finishes like gravel or paving stones for ballast. The finishes applied to the roof in

this discussion covered roofs like Wood Shingle roof, Concrete tiles roof, Corrugated aluminium roof and Flat roof as shown in ***Figure 5.19.1.***

Figure 5.19.1: Example of shingle roof, concrete tiles roof, Corrugated aluminium roof and flat roof.

Wood Shingle Roof

Wood shingles are thin, tapered pieces of wood used to cover roofs. They're machine-cut for uniformity and laid in overlapping rows. These roofs are thin, tapered pieces of wood used for roofing. They are made from wood, often such as cedar, Emeri, redwood, or pine. Wood shingles are known for their ability to insulate, withstand wind and impact. Installing wood shingles involves laying them in a staggered pattern, ensuring proper overlap and secure fastening with corrosion-resistant nails. Shingles are ideal in areas of high humidity. Shingles are normally laid upon a rafter and purlin carcass, with felt used as sheathing beneath the shingles as the final finish.

Figure 5.19.2: Picture of a Wood Shingle roof

Key Features of the Wood Shingle Roof

a. Natural appearance with rustic charm

b. Good insulation properties

c. Lightweight

Advantages of a Wood Shingle Roof

a. Aesthetic appeal for traditional or cottage-style buildings

b. Biodegradable and eco-friendly

c. Can last 30–50 years with proper maintenance

Disadvantages of Wood Shingles

a. Vulnerable to fire unless treated

b. Requires regular maintenance to prevent rot or insect damage

c. Not ideal for very wet or humid climates

Concrete Tiles Roof

Concrete tiles are moulded from a mix of sand, cement, and water. They mimic clay tiles or slate and are laid in overlapping rows. The concrete tiles are produced as interlocking flat pan tiles to be supported on timber battens, which are fixed to rafters. Concrete tiles are produced from Portland cement and sand, which has a high quartzite content. The roof finish needs to be laid on a strong carcass, they are very durable with a very long life. If laid properly, they need little or no maintenance. They can withstand impact and turbulent wind. The sea breeze has no adverse effect on the finished concrete tile. ***Figure 5.19.3*** shows an example of concrete roofing tiles.

Figure 5.19.3: An example of a concrete tile roof

Key Features of Concrete Tiles Roof

a. Heavy and durable

b. Available in various shapes and colours

c. Fire-resistant

Advantages of Concrete Tile Roofs

a. Long lifespan (up to 50 years or more)

b. Low maintenance

c. Excellent thermal mass for energy efficiency

Disadvantages of Concrete Tile Roofs

a. Heavy—requires strong roof framing

b. Installation is labour-intensive

c. Can crack under impact (e.g., falling branches)

Corrugated Aluminium Roof

Made from sheets of aluminium shaped into a wavy (corrugated) pattern for added strength. Common in industrial, agricultural, and modern residential buildings. A corrugated aluminium roof, if well insulated and ventilated, can be an economical, light and durable roofing material to use. The corrugated aluminium roofs do not require a strong Carcass. Aluminium corrugated sheets are produced in an increasingly wide range of profiles and gauges, which are used in residential, public and institutional buildings with different accessories such as bolts, self-tapping screws with washers. Corrugated sheets can be fixed with a side lap of not less than two full corrugations; troughed sheets are usually fixed with one single side lap in tropical conditions. Similar to Corrugated Aluminium Sheets, galvanised steel sheets are used, but if they are exposed to sea breeze, they can be covered with a zinc galvanised coating to be painted with any oxide paint in order to avoid corrosion of the material. ***Figure 5.19.4*** shows an example of a corrugated aluminium roof.

Figure 5.19.4: An example of a corrugated aluminium roof

Key Features of Corrugated Aluminium Roof

a. Lightweight and rust-resistant

b. Reflective surface reduces heat absorption

c. Easy to install

Advantages of Corrugated Aluminium Roof

a. Long-lasting and low maintenance

b. Recyclable and eco-friendly

c. Performs well in coastal and rainy areas

Disadvantages of Corrugated Aluminium Roof

a. Noisy during rain unless insulated

b. Less aesthetic appeal for some building styles

c. Can dent under heavy impact

Flat Roofs

Flat roofs have a slight pitch (usually 1–10°) to allow water drainage. Commonly used in commercial buildings and modern homes. Flat roofs are of concrete slabs serving as the final roof finishes. Flat roofs are mostly used in places with arid climates where the roof space can be used for relaxation and other purposes. EPDM, or Ethylene Propylene Diene Monomer, is a synthetic rubber material that is widely used on flat roofs. It is a durable and flexible material that can withstand extreme temperatures, UV radiation, and weathering, making it ideal for waterproofing and sealing applications. Top of FormBottom of Form ***Figure 5.19.5*** shows a concrete flat roof treated with waterproofing chemicals.

Figure 5.19.5: Flat roof made of concrete

Key Features of Flat Roofs

a. Simple design and easy access

b. Often finished with materials like bitumen, EPDM rubber, or concrete

Advantages of Flat Roofs

a. Space-efficient (can host solar panels, HVAC units, or roof gardens)

b. Easier and safer to inspect or maintain

c. Cost-effective for large buildings

Disadvantages of Flat Roofs

a. Drainage issues if not properly sloped

b. Shorter lifespan than pitched roofs

c. Requires waterproofing and regular inspection

FACTORS TO CONSIDER WHEN SELECTING A ROOF FINISH

The choice of a roof finish is usually influenced by some factors to guide in making a very good decision. By carefully considering these factors, you can select the best roof finish for your specific needs and ensure a durable, aesthetically pleasing, and cost-effective roofing solution. ***Table 5.19.1*** provides the factors that can help in choosing the right type of roof finish. Your thorough and critical study of the table will be of great help in your understanding of roof finishes.

Table 5.19.2: *Considerations for Choosing a Roof Finish*

FACTORS	DESCRIPTION
Climate	In hot climates, consider materials with high solar reflectance to reduce cooling costs.
Durability	Choose a material that can withstand local weather conditions, such as high winds, heavy rain, or snow.
Aesthetics	Consider the architectural style of the building and the desired look of the roof.
Cost	Factor in the initial cost of materials and installation, as well as long-term maintenance costs.
Lifespan	Consider the expected lifespan of the material and whether it aligns with the building's needs.
Maintenance	Some materials require more maintenance than others.

The Appropriate Finish To Apply Given The Geographical Location Of The Roof

When selecting an appropriate roof finish, geographical location plays a critical role due to the impact of climatic conditions on the performance and durability of the roofing material. Below is a structured discussion on the appropriate finish to apply, considering key geographical and climatic factors.

Table 5.19.3: *Climatic Zones and Their Implications*

Location	Challenges	Recommended Finish
Tropical (Hot & Humid Climates) – e.g., Southeast Asia, Central Africa	High humidity, heavy rainfall, intense UV exposure, and mould/mildew growth.	• **Reflective or Cool Roof Coatings:** Reduce heat absorption (e.g., elastomeric coatings). • **Waterproofing Finishes:** Bituminous coatings or polyurethane-based membranes to prevent water infiltration. • **Anti-Fungal/Mould Resistant Finishes:** Acrylic coatings with biocides.
Arid and Semi-Arid (Hot & Dry Climates) – e.g., Middle East, Northern Africa	High temperatures, UV radiation, thermal expansion, and sand abrasion.	• **UV-Resistant Coatings:** Silicone or acrylic-based finishes with UV stabilisers. • **Light-Coloured or Reflective Finishes:** Reduce heat gain and energy usage. • **Abrasion-Resistant Finishes:** Hard, smooth surfaces to resist sand damage.
Cold/Temperate Zones – e.g., Northern Europe, Canada	Snow, ice, freeze-thaw cycles, water ingress.	• **Elastomeric Coatings:** Flexible to accommodate thermal expansion and contraction. • **Bituminous Membranes:** Provide excellent waterproofing and withstand cold temperatures. • **Slip-Resistant Finishes:** Important for maintenance safety in icy conditions.
Coastal or Marine Areas – e.g., Pacific Islands, Caribbean	High salt content, humidity, corrosion.	• **Anti-Corrosive Coatings:** Especially for metal roofs (e.g., epoxy or polyurethane). • **Sealants Resistant to Salt Exposure:** Silicone-based products. • **UV-Resistant and Waterproof Finishes:** Prevent degradation due to sun and salt-laden air.

Table 5.19.4: *Additional Factors Based on Location*

FACTORS	DESCRIPTION
Urban Heat Islands	In cities, reflective or cool roofing finishes help reduce energy costs and urban temperatures.
High Wind Areas	Finishes must not peel easily; adhesive strength and wind uplift resistance are key.
Seismic Zones	Lightweight finishes like aluminium or TPO membranes are preferable to reduce structural load

Sustainability and Energy Efficiency Considerations

1. In warm climates, cool roof finishes lower cooling loads and reduce greenhouse gas emissions.
2. In cold climates, darker finishes may be preferred for heat absorption, aiding passive heating.

Conclusion

In the selection of roof finishes, the following factors must be considered.

- Climatic stresses (UV, rain, wind, salt, snow)
- Material compatibility
- Aesthetic and energy performance needs
- Durability and maintenance requirements

Proper finish selection not only extends roof lifespan but also enhances occupant comfort and reduces long-term maintenance and energy costs.

Activity 5.19.1 Exploring Roof Finishes: Selection, Technology, and Application

Scenario: Your group is part of a construction project team building a large school. Each member of the group is responsible for researching, documenting, and presenting a specific aspect of roof finishing. Together, your group will compare findings and create one strong recommendation for the project.

Materials Needed

- Samples of roof finishes (corrugated sheets, shingles, tiles, thatch)
- Charts/images of roof finish types and applications

- Samples of adhesives and sealants
- Roof finishing accessories (nails, screws, flashing)
- Tool set (hammer, drill, tape measure, safety gear)
- Notebooks, pens, markers
- Access to internet-enabled devices

Activity Guidelines

1. Individually select one roof finish type to investigate.
2. Research its appearance, durability, cost, and suitability for different climates.
3. Record your findings in your notebook.
4. Organise yourself into a group of 3-5 members.
5. Share your personal research with your group.
6. In your group, compare the impact of each finish on school building performance (weather resistance, maintenance needs, cost).
7. Agree on the most suitable finish for the school's location and explain why.
8. Individually research and present one tool, adhesive, or accessory needed for your roof finish.
9. In your group, compile a complete toolkit and materials list.
10. Visit a nearby construction site or material sales point.
11. Take photos or short videos of the roof finishes and tools you studied.
12. Prepare a short reflective note on how real-life observation confirmed or challenged your earlier research.
13. In your group, present your final recommendation, with each member explaining their part of the research.
14. In a whole-class discussion, compare similarities, differences, and lessons learned from various group approaches.

Conclusion

Finishes on roof carcasses protect the structure from weather damage, improve appearance, and extend durability. The choice of finish depends on the climate, building style, and budget. Common finishes like roofing sheets, tiles, shingles, or thatch each have unique benefits in strength, beauty, and comfort. Selecting the right finish ensures a safe, attractive, and long-lasting roof.

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REVIEW QUESTIONS

1. A client's building in a coastal area is experiencing premature deterioration of roof finishes. Analyse how you would adjust your specifications for roof finishes in such areas to address environmental factors while maintaining aesthetic appeal.
2. Analyse how the functional requirements for roof finishes differ across different climate zones. Suggest the appropriate roof finishes that address the primary environmental challenges in zones such as the coast and the tropical rainforest.

UNIT 20

BUILDING CONSTRUCTION TECHNOLOGY

SUBSTRUCTURE AND SUPERSTRUCTURE

Introduction

Ceiling joists are horizontal structural members that support the ceiling and help tie together the walls of a building. While their primary role is structural, ceiling joists can also be finished to enhance the appearance and function of a space. Finishes applied to ceiling joists serve both decorative and protective purposes. They can highlight the natural beauty of wood, create a rustic or modern look, or blend seamlessly with the overall interior design. Common finishes include paint, stain, varnish, and sealants, each offering different levels of colour, texture, and durability. In exposed ceiling designs, finished joists become a key visual element, adding character and warmth to the room. In addition to aesthetics, finishes help protect joists from moisture, insects, and wear over time. Choosing the right finish depends on the material of the joists, the desired look, and the environmental conditions of the space.

KEY IDEAS

- Ceiling joists are structural parts that can also be finished for decoration.
- Common finishes include paint, stain, varnish, and sealants.
- Finishes also protect joists from moisture, insects, and damage.
- Finishes help improve the look of exposed joists in a room.
- The best finish depends on the joist material and room conditions.
- These finishes can make joists look rustic, modern, or natural.

FINISHES APPLIED TO CEILING SURFACE/ CARCASS GIVEN FUNCTIONS OF SPACE

Gypsum Boards for Ceilings

Gypsum boards (also called drywall or plasterboards) are flat panels made of gypsum sandwiched between paper layers. They are commonly used for ceiling finishing because they are:

1. Lightweight and easy to install
2. Fire-resistant and sound-absorbing
3. Smooth and paint-ready

Figure 5.20.1: Gypsum board ceiling.

Installation Methods used for gypsum board ceilings (Step-by-Step)

1. **Prepare the Area**
   - **a.** Clean and level the ceiling surface
   - **b.** Measure and mark the layout for ceiling joists or framing
2. **Install Metal or Wooden Framing**
   - **a.** Use metal channels (like furring channels) or wooden battens
   - **b.** Ensure spacing is typically 400–600 mm apart
3. **Cut and Position Gypsum Boards**
   - **a.** Use a utility knife to cut boards to size
   - **b.** Position boards perpendicular to framing
4. **Fix Boards to Framing**
   - **a.** Use a power drill/screw gun with drywall screws
   - **b.** Leave slight gaps between boards for jointing
5. **Tape and Joint Treatment**
   - **a.** Apply joint tape and joint compound with a putty knife
   - **b.** Smooth out seams for a flush finish
6. **Sanding and Finishing**

a. After drying, use a sanding block or sanding pole to smooth joints
b. Apply paint, texture, or ceiling finish as desired

Common tools used for gypsum board ceiling

a. Measuring tape
b. Level
c. Utility knife
d. Power drill/screw gun
e. Joint tape and compound
f. Putty knife
g. Sanding block or pole

Soft Boards for The Ceiling

Soft boards are lightweight panels made from materials like compressed fibre board, cork, or other acoustic composites. They are used in ceilings for:

1. Acoustic absorption (reduces echo and noise)
2. Thermal insulation
3. Aesthetic finishes
4. Ease of installation

They are commonly found in offices, schools, conference rooms, and residential spaces needing sound control and a softer appearance.

Figure 5.20.2: Example of a soft board used for the ceiling

Installation Method for Soft Boards (Step-by-Step)

1. **Site Preparation**
   a. Clean and measure the ceiling area.
   b. Mark the layout according to panel size.

2. **Framing Grid Setup**
   a. Fix lightweight aluminium or wooden battens on the ceiling.
   b. Use a laser level or chalk line for precision.
3. **Cut Panels (if needed):** Use a sharp utility knife or handsaw to cut soft boards to size.
4. **Fixing the Soft Boards**
   a. Position soft boards within the grid.
   b. Fasten using nails, screws, or adhesive, depending on the product type.
5. **Finishing Touches**
   a. Add edge trims or corner strips for a clean look.
   b. Paint or apply surface finishes if required.

Tools Required for Soft Boards

a. Measuring tape
b. Level or laser level
c. Utility knife or handsaw
d. Screwdriver or drill
e. Adhesives or nails
f. Chalk line
g. Safety gear (gloves, goggles)

Hardwood Strips For The Ceiling

Hardwood strips are slender, durable wooden panels often made from species like oak, teak, mahogany, or walnut. They are used in ceiling finishes to:

1. Enhance visual appeal with natural wood grain
2. Add warmth and elegance to interior spaces
3. Improve acoustics and thermal insulation slightly
4. Increase property value with a high-end finish

They are popular in homes, hotels, offices, and showrooms for a luxurious look.

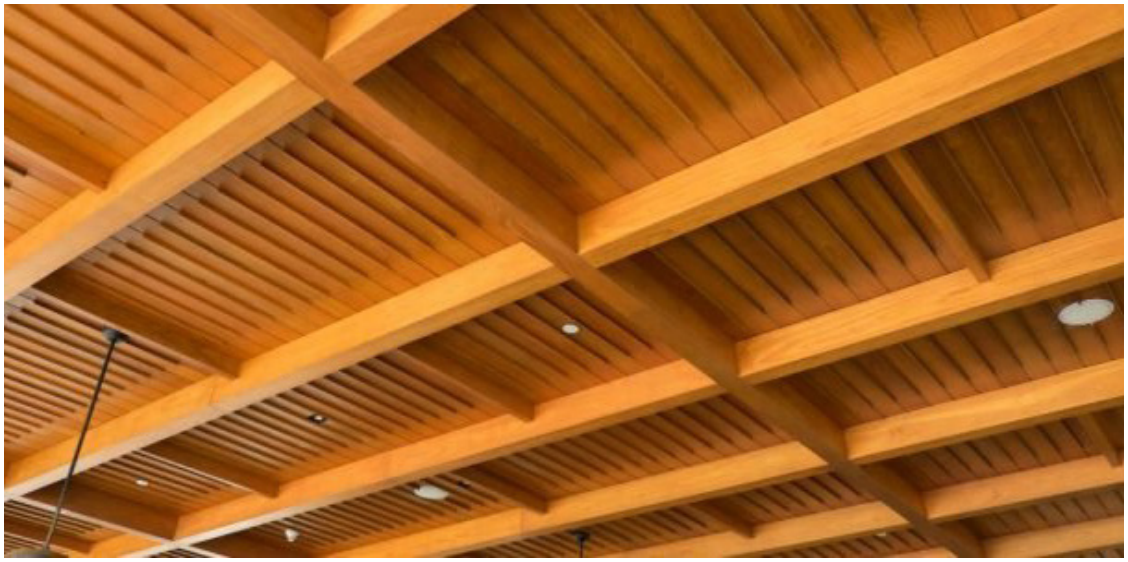

Figure 5.20.3: Hardwood strips for ceiling.

Installation Method for Hardwood Strips (Step-by-Step)

1. **Site Preparation**
   - **a.** Inspect and clean the ceiling surface.
   - **b.** Measure and mark layout lines for strip placement.
2. **Support Frame Installation**
   - **a.** Fix wooden battens or metal furring channels as a support grid.
   - **b.** Ensure alignment using a level or laser.
3. **Strip Preparation**
   - **a.** Cut hardwood strips to length using a table saw or circular saw.
   - **b.** Sand edges if necessary for smoothness.
4. **Mounting Strips**
   - **a.** Attach strips to the battens with nails or wood screws.
   - **b.** For a seamless look, use tongue-and-groove joints or hidden fasteners.
5. **Finishing**
   - **a.** Fill gaps and holes with wood filler.
   - **b.** Apply wood polish, varnish, or clear coat for protection and shine.

Tools Required for Hardwood Strips

- **a.** Tape measure and pencil
- **b.** Level or laser level
- **c.** Table saw or circular saw
- **d.** Drill or screwdriver

e. Hammer or nail gun
f. Sandpaper or sanding block
g. Wood filler and finish (varnish/polish)
h. Safety gear (gloves, goggles, dust mask)

Plywood for The Ceiling

Plywood is a manufactured wood panel made from thin sheets (plies) of wood veneer, glued together in layers. It's popular for ceilings due to:

1. **Stability and Strength:** The cross-layered structure resists warping.
2. **Aesthetic Versatility:** Can be finished with paint, varnish, or laminates.
3. **Cost Efficiency:** Generally, more affordable than solid wood planks.
4. **Ease of Installation:** Lighter and easier to handle than many alternatives.

Typical ceiling plywood is about 6mm–12mm thick, often with a smooth surface grade (e.g., BB/CC or better) to allow for finishing.

Figure 5.20.4: Plywood boards used for the ceiling.

Table 5.20.1: *Tools used for plywood ceiling*

Tools	Purpose
Tape Measure	For precise ceiling area measurement
Chalk Line	To mark straight guidelines
Circular Saw / Jig Saw	For cutting plywood sheets to size
Power Drill	For screwing plywood into place
Screws and Screwdriver	To fix sheets to ceiling joists
Stud Finder	To locate ceiling supports
Ladder / Scaffolding	To reach ceiling height safely

Method of installation for plywood ceiling

1. **Preparation**
   - **a.** Measure the ceiling dimensions and mark joist positions.
   - **b.** Cut plywood sheets to fit, allowing for light fixtures or vents.
2. Fixing Framework (if not already in place): Ensure ceiling joists or battens are secure and spaced appropriately (typically 16”–24” apart).
3. Sheet Installation
   - **a.** Lift plywood sheet into position using a helper or support.
   - **b.** Drill pilot holes, then fasten with screws along the edges and centre.
   - **c.** Repeat across the ceiling, staggering joints if possible.
4. Finishing
   - **a.** Fill any gaps or screw holes with wood filler.
   - **b.** Sand the surface lightly.
   - **c.** Apply primer, paint, or stain for your desired finish.

TYPES OF EQUIPMENT/ADHESIVES USED

Adhesives used in construction and various applications can be broadly categorised into several types, each with its own unique properties and uses. Some common types include epoxy adhesives, polyurethane adhesives, acrylic adhesives, silicone adhesives, and MS polymers (hybrid). Additionally, there are reactive adhesives like hot melt and cyanoacrylate, as well as non-reactive options such as pressure-sensitive adhesives and solvent-based adhesives. Equipment used for applying adhesives includes spreaders, hand rollers, V-manifolds, bead applicators, and weighted rollers.

Table 5.20.2: *Types of Adhesives:*

ADHESIVES	DESCRIPTION
Epoxy Adhesives	Known for high strength, durability, and resistance to temperature and solvents. They can bond to a wide range of materials like metals, ceramics, wood, and plastics.
Polyurethane Adhesives	Offer high strength and permanent elasticity, making them suitable for construction and transport applications. They require moisture to cure.
Acrylic Adhesives	Versatile adhesives that offer good adhesion to various materials and are used in a wide range of applications.
Silicone Adhesives	Known for their flexibility, water resistance, and ability to withstand extreme temperatures.
MS Polymers (Hybrid)	Offer a combination of properties from different types of adhesives, providing versatility and performance.

Reactive Adhesives	These adhesives undergo a chemical reaction to harden; examples include epoxy and polyurethane.
Hot Melt Adhesives	Solid at room temperature and melts when heated, forming a strong bond upon cooling.
Cyanoacrylate Adhesives	Commonly known as super glue, offering fast-setting and instant adhesion.
Non-Reactive Adhesives	These adhesives do not undergo a chemical reaction to harden.
Pressure-Sensitive Adhesives	Require pressure to bond and are used in tapes and labels.
Solvent-Based Adhesives	Use a solvent to carry the adhesive and evaporate, leaving behind a bond.
Water-Based Adhesives	Use water as a carrier and are known for their ease of use and low VOCs.

Table 5.20.3: *Equipment for Applying Adhesives*

EQUIPMENTS	DESCRIPTION
Spreaders	Used to apply a thin, even layer of adhesive.
Hand Rollers	Help to distribute the adhesive and apply pressure for better bonding.
V-Manifolds	Dispense adhesive in a precise V-shape pattern.
Bead Applicators	Used to apply adhesive in a continuous bead or line.
Weighted Rollers	Apply consistent pressure to ensure proper bonding.
Dispensing nozzles	Used for applying adhesive in dots or beads, often with precision.
Spray equipment	Used for applying adhesives in a fine mist, suitable for large surfaces.
Applicators	Can be manual, like squeeze bottles, or automated for industrial use.

Activity 5.20.1 Exploring and Applying Ceiling Joist Finishes

Scenario: You are part of a design and construction team preparing a new classroom ceiling. Your role is to help your group choose the most suitable finish for the ceiling joists based on the function of the space. You must also decide the best method for applying the finish and identify the tools, adhesives, and accessories needed to do the job efficiently.

Materials Needed

- Samples of ceiling finishes (paint, varnish, PVC panels, acoustic boards, gypsum boards, etc.)
- Catalogues or brochures from finish suppliers
- Tool samples or pictures (rollers, brushes, trowels, cutting tools, ladders)
- Adhesive samples (construction glue, screws, nails, joint compound)

- Chart paper, markers, sticky notes

Activity Guidelines

1. Organise yourself into a group of 4 members.
2. Assign roles (researcher, note-taker, presenter, designer).
3. In your group, each person should:
   a. Share one ceiling finish they think suits the classroom and explain why.
   b. Suggest a method for applying that finish.
   c. List tools, adhesives, and accessories needed.
3. After sharing, combine your ideas into one agreed choice.
4. Individually examine the samples, brochures, or watch videos to gather details about the finish your group selected. Take your own notes before combining findings with your group.
5. Prepare a group chart/model. Encourage each member of your group to speak during the presentation, explaining at least one feature of the finish.
6. During other groups' presentations, write down at least two ideas or improvements you would suggest.
7. Write a short note on:
   a. One thing you learned about ceiling joist finishes.
   b. How does your input help the group make decisions?
8. Find one new ceiling finish type in your community that was not covered in class and prepare a one-paragraph summary with a picture for the next lesson.

Conclusion

Finishes on ceiling joists improve the look, protect the wood or material, and increase its lifespan. The right finish depends on the function of the space, the desired appearance, and the budget. Common finishes like paint, varnish, PVC panels, acoustic boards, and gypsum boards each offer unique benefits in beauty, protection, and comfort. Choosing the right one ensures a strong, attractive, and long-lasting ceiling.

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Schreckenback, H. (1981). Construction Technology for a Tropical Developing Country. Published in Germany. Pages 150–250.

REVIEW QUESTIONS

1. Compare three ceiling types (plywood, plaster of Paris and timber panels) in terms of their lifecycle functional performance in a school environment. Evaluate factors including initial cost, durability, maintenance requirements, ease of replacement and life span.
2. A building with exceptionally high ceilings requires extensive finish installation. Analyses the challenges this height creates for adhesive application, tool operation, and equipment deployment.

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GLOSSARY

Abrasion	Wearing away of a surface due to friction or rubbing.
Abrasive	A material or substance used to grind, polish, or clean surfaces by friction.
Accessibility	The ease with which people, especially rural or marginalised groups, can use or benefit from forest products.
Accuracy	How close a machine's action or cut is to the expected result.
Acoustic	Related to sound or the sense of hearing.
Acoustic benefit	Any improvement in how sound behaves in a space, like reducing noise or enhancing clarity.
Acoustic fabric	A special material designed to absorb sound and help control echo or noise in a room.
Acoustic panel	A board or section used on walls or ceilings to manage sound reflection and improve room acoustics.
Acoustics	The science of sound; how sound behaves in a space.
Adjustment	The act of changing a machine's settings to make it work correctly for a specific task.
Advertisement	A message used to promote or sell a product to customers.
Agroforestry	A land-use system where trees are grown together with crops or animals to improve production and biodiversity.
Air Pollution	The release of harmful dust, fumes, or chemicals from woodwork activities into the air.
Alignment	The correct positioning of machine parts to ensure smooth and accurate operation.
Alternative Timber	Timber that is not commonly used but can replace popular ones like mahogany or Odum.

Ambience	The mood or atmosphere of a place.
Ambience	The overall mood, tone, or atmosphere of a place, often felt through lighting, design, and sound.
Assembly Line	A system where furniture parts are added step-by-step by different workers or machines until the product is complete.
Auger Bit	A drill bit used in a mortiser to remove wood from the inside of a hole.
Automated	A process done by a machine or computer with little or no human help.
Automation	The use of machines to do tasks without much human effort.
Availability	How easy or possible it is to find a particular material or product in an area.
Backfilling	Refilling a trench or hole after construction work.
Bamboo	A fast-growing plant used for making furniture, bikes, building materials, and crafts.
Barrier	A structure or material that blocks or limits movement or access.
Batch Production	Making a set number of the same product before switching to another.
Belt	A flexible loop used to connect and transfer motion between machine parts like pulleys.
Belt Drive	A system that transfers power from a motor to a spindle using a belt.
Biodegradable	Capable of being broken down naturally by microorganisms.
Biodiversity	The variety of plant and animal life in a natural environment affected by deforestation.
Biodiversity	The variety of plants, animals, and organisms in a specific environment.
Biodiversity	The variety of plants and animals in the forest that keeps the ecosystem healthy and strong.
Blade	A sharp-edged tool or part used in machines for cutting materials like wood.

Blueprint	A detailed drawing or plan used to guide the production of furniture.
Blueprints	Detailed architectural or engineering drawings that guide construction.
Bonding	The process of joining materials together using adhesives or other methods.
Branding	Creating a unique name, logo, or image that makes a business stand out.
Budget	A plan for how to spend and manage money in a business.
Building components	The individual parts or materials that come together to form a complete structure.
Building regulations	Rules that guide how buildings should be safely constructed.
CAD (Computer-Aided Design)	Software used to draw and design parts or shapes before making them.
Calibration	Adjusting tools or instruments to ensure accurate measurements.
Calibration	The process of adjusting a machine to measure or work accurately.
CAM (Computer-Aided Manufacturing)	Software that converts designs into instructions for a CNC machine.
Cane	A flexible forest plant used to make baskets, chairs, and decorative items.
Capital	The money or resources needed to start or run a business.
Carbon Emissions	Greenhouse gases released during wood processing that contribute to climate change.
Carcass	The main structural frame of a building or object, often before any finishing work is done.
Categorisation	Grouping items based on shared characteristics.
Ceiling joist	A horizontal beam that helps support the ceiling and contributes to holding up the roof structure.
Cellular Manufacturing	A method where small teams produce parts of furniture in groups to increase efficiency.

Chuck	A part of a machine that holds a tool or bit tightly in place.
Civil infrastructure	Basic structures like roads, bridges, and water systems that support a community.
Cladding	A layer of material applied to the exterior of a building for protection or appearance.
Clamping Device	A tool used to hold wood firmly on a machine table during cutting or shaping.
Classification	Grouping timber and non-timber products based on their type, use, or source.
Climate factors	Environmental conditions such as temperature, humidity, and rainfall that can affect materials or construction.
CNC (Computer Numerical Control)	A system that uses computer programs to control machine tools automatically.
CNC (Computer Numerical Control)	A machine controlled by a computer to cut or shape materials precisely.
Code-compliant electrical system	An electrical setup that meets legal safety and building standards.
Cold water installation	A system for delivering cold water throughout a building.
Components	Individual parts that make up a whole system or structure.
Condensation	Water droplets form when warm air meets a cold surface.
Conduit	A tube or channel that protects and routes electrical wiring.
Conservation	The careful use of natural resources to avoid waste and protect forests for future use.
Conservation	The careful use and protection of natural resources to prevent waste and damage.
Conservation	The careful use and protection of forest resources to keep them for future generations.
Control systems	Devices or software that manage and regulate the operation of machines or processes.

Corrosion	Gradual destruction of materials, usually metals, by chemical reactions.
Corrosive	A substance or condition that causes slow, damaging effects—especially on metals.
Cost-effective	Something that delivers good results or value without costing too much.
Cost-effective	Producing furniture at a lower cost without reducing quality.
Cost-effectiveness	Achieving the best result with the least expense.
Customer	A person who buys goods or services from a business.
Customisation	Modifying something to suit specific needs or preferences.
Cutter Head	The part of a machine that holds and spins the cutting tool.
Cutting Tool	A sharp part of a machine used to shape, slice, or remove material from wood.
Danta (Kotibe)	A lesser-used timber species known for its strength and used in flooring and heavy furniture.
Debris	Waste materials like dust, shavings, or chips that collect in and around machines.
Deforestation	The large-scale cutting down of trees without replanting, leading to forest loss.
Deforestation	The cutting down of forests, often leading to the loss of species and resources.
Deforestation	The cutting down of trees without replacing them, which destroys forest life.
Demand	The desire of people to buy a particular wood product.
Deterioration	The process of becoming worse or declining in quality.
Documentation	Written records or instructions related to a project or system.
Drainage	System for removing excess water or waste.
Drainage system	A network that removes excess water or waste.

Drum Sander	A sanding machine with rotating drums used to smooth wood surfaces.
Eccentric Fence	A rounded fence used to guide curved or shaped wood pieces.
Economic Value	The money or benefit that people can get from using forest products like timber, fruits, or herbs.
Ecosystem	A natural community of living and non-living things that can be harmed by wood industry activities.
Efficiency	Doing work quickly and correctly without wasting time or materials.
Efficiency	Doing something with minimal waste of time, energy, or resources.
Electrical components	Parts like wires, switches, and circuits that make up electrical systems.
Electricity supply	The system that provides electrical power to buildings or areas.
Embankment	A raised structure of earth or stone to hold back water or support a road.
Employment	Jobs or work created through the harvesting and processing of forest products.
Energy efficiency	Using less energy to perform the same task or produce the same result.
Enhancement	An improvement that increases value, quality, or attractiveness.
Entrepreneur	A person who starts and manages a business to make a profit.
Environmental performance	How well something protects or benefits the environment.
Environmental pollution	Harm caused to nature by harmful substances.
Environmental protection	Actions taken to safeguard nature and reduce pollution.
Environmental sustainability	Protecting nature so resources last for future generations.

Erosion	The wearing away of soil due to the removal of trees that hold the soil in place.
Excavation	Digging out earth to prepare for construction.
Fault	A problem or damage in a machine that affects its performance.
Feed Mechanism	A part of the machine that moves wood into the cutting tool.
Fixtures	Tools used to hold wood in place during cutting or shaping.
Fixtures	Permanent devices like lights or sinks installed in buildings.
Floors	The lower surface of a room on which one walks.
Forest	A large area of land covered with trees and plants that provides wood, food, medicine, and clean air.
Forest Reserve	A protected area of forest managed for sustainable use and conservation.
Frequency	How often something happens.
Fumes	Harmful gases released from paints, glues, or machines used in woodwork.
Functional environment	A space designed to support work, living, or other specific activities effectively.
Functionality	How well something works and serves its intended purpose.
Furniture	Items such as chairs, tables, and beds made from wood or rattan for homes and offices.
Geographical	Related to the physical location, land features, or terrain of a specific area.
Geotextiles	Fabric used in the ground to improve soil stability and drainage.
Grates	Metal or plastic covers with holes, used to drain water.
Grinding Machine	A machine that sharpens or polishes tools and wooden surfaces.
Grooving	Cutting a narrow channel or slot into wood, usually for joining or decoration.

Habitat Loss	The destruction of natural homes for animals due to logging and deforestation.
Harvest	The process of cutting or collecting timber or NTFPs from the forest.
Harvesting	The act of collecting or gathering forest resources like timber or NTFPs.
Hazardous	Dangerous or harmful to health or safety.
Health risk	Chance of getting sick or injured.
Hospitality	The warm and friendly treatment of guests, especially in hotels, restaurants, or tourism settings.
HVAC	Heating, Ventilation, and Air Conditioning systems that regulate indoor temperature and air quality.
Indigenous Trees	Trees that naturally grow in a particular place, like Ghana, and are not brought from outside.
Innovation	Creating new or improved products to meet customer needs.
Inspection	A careful check of the machine to find problems or ensure it works correctly.
Installation	The act of setting up or putting something in place for use.
Installations	The process of setting up equipment or systems so they're ready to use.
Insulation	Material used to prevent heat, sound, or electricity from escaping or entering.
Insulation	Material used to keep heat, cold, or sound from passing through.
Interconnected protection	Safety systems linked together to respond collectively in case of danger, like fire alarms.
Inventory	A list of products, tools, or materials a business has in stock.
Investment	The money and tools needed to start using forest products like LKS or NTFPs.
Jigs	Devices that guide tools to make repeated, accurate cuts or shapes.

Joinery	The method of connecting two pieces of wood using joints.
Landscape	The visible features of land, including plants and terrain.
Lathe Machine	A machine that turns wood while cutting tools shape it into round forms.
Lesser Used Timber Species (LUS)	Timber species that are not frequently used in the market but can be good alternatives.
Lesser-Known Species (LKS)	Timber species that are not commonly used but have good qualities.
Lesser-Known Timber Species (LKS)	Underused tree types that can help reduce pressure on popular trees.
Lesser-Known Timber Species (LKS)	Wood types that are not widely used but can be used for construction and furniture.
Lesser-Known Timber Species (LKS)	Timber trees that many people don't know or use often, but they have good-quality wood.
Lesser-Used Species (LUS)	Timber species that are available but not often selected for use.
Lesser-Used Timber Species (LUS)	Timber species that have potential but are not commonly chosen for woodwork.
Lifecycle	The stages something goes through from creation to disposal or renewal.
Liquid waste	Waste in liquid form, like dirty water or chemicals.
Load balancing	Distributing power or work evenly across a system to avoid overload.
Logging	The act of cutting down trees for timber.
Logistic	Planning and moving things efficiently.
Low voltage systems	Electrical systems that operate at a lower power level, often used for lighting, security, and communication.
Lubrication	Applying oil or grease to moving parts to reduce friction and wear.
Machinery	Equipment like saws, drills, and sanders used in mass production.

Maintenance	The regular care given to machines to keep them in good condition.
Maintenance schedule	A plan for regular checks and repairs.
Market	A place or group where wood products are sold or exchanged.
Marketing	Activities used to promote and sell products to customers.
Masking	The act of covering or hiding something, usually for protection or appearance.
Mass Production	Making many similar furniture items quickly using machines and standard steps.
Medicinal Plants	Plants found in the forest that can be used to treat sickness and boost health.
Membranes	Thin sheets or layers used to protect, seal, or cover surfaces.
Moist Forest Zone	Areas with high rainfall and rich forest cover, suitable for many tree species.
Mortise	A hole or slot cut into wood to receive a tenon for a joint.
Mortising Machine	A machine used to cut square or rectangular holes (mortises) in wood.
MS polymers	Strong yet flexible construction sealants used for bonding and sealing, known for their durability.
Natural Resource	Anything useful that comes from nature, like wood, water, herbs, or minerals.
Noise Pollution	Loud sounds from machines and tools that disturb people and animals.
Non-Timber Forest Product (NTFP)	Any useful thing from the forest that is not wood, such as honey, fruits, seeds, and oils.
Non-Timber Forest Products (NTFPs)	Forest resources that are not wood, such as rattan, bamboo, fruits, herbs, or leaves.
Non-Timber Forest Products (NTFPs)	Useful products from the forest that are not wood, like fruits, honey, or rattan.
Operation of appliances	The way machines or devices are used to perform tasks.

Organic	Natural material from plants or animals.
Overheating	A condition where a machine becomes too hot and may be damaged.
Panelling	Decorative or protective panels fixed to walls or ceilings.
Permeability	Ability of a material to let water or air pass through.
Plantation	A large area of land where trees or crops are grown in organised rows.
Plaster	A paste used to coat walls and ceilings, which hardens when dry.
Plumbing	Systems for water supply and waste removal in buildings.
Polyurethane	A synthetic resin used in foams, coatings, and adhesives.
Powering up	Activating or turning on a system or device.
PPE (Personal Protective Equipment)	Safety gear like gloves, goggles, and nose masks worn during maintenance.
Precision	The ability of a machine to produce exact and detailed work without errors.
Pressure Sensitive	Reacts to applied pressure, often used in adhesives that stick when pressed.
Pricing	Setting the right amount of money to charge for a product.
Processing	Changing raw materials like timber into usable products through cutting, drying, or treating.
Production	The process of making wood items for sale.
Production Line	A sequence of workstations where each task is done in order.
Profile	The shape or design cut into the edge or surface of wood.
Profit	The money a business earns after paying all expenses.
PVC ceiling	A lightweight and water-resistant ceiling material made from polyvinyl chloride plastic.

Quality Control	Checking products to make sure they meet the required standard.
Rattan	A climbing plant used to make baskets, chairs, and cane furniture.
Rebating	Cutting a step-shaped recess along the edge of wood, often for fitting parts together.
Recyclable	Can be reused or made into something new.
Reflectance	How well a surface reflects light or heat instead of absorbing it.
Reforestation	Planting new trees to replace those that were cut down.
Renewable sources	Energy that comes from natural, refillable sources like wind or sunlight.
Resilient	Able to recover quickly or resist damage.
Roof carcass	The basic skeletal structure of a roof before tiles, sheets, or other coverings are added.
Router	A machine used to cut grooves, edges, and decorative shapes in wood.
Router	A high-speed shaping machine used to cut designs, grooves, and joints in wood.
Rust	A reddish-brown layer that forms on metal parts when they are exposed to moisture, causing damage.
Rustic	A style that looks natural, rough, or aged—often inspired by rural or countryside design.
Safety Gear	Equipment like goggles and gloves used to protect the body during machine work.
Safety standards	Rules or guidelines to keep people and environments safe.
Sanitisation	Cleaning to remove germs and make something safe.
Schedule of works	A plan outlining when tasks or construction steps will happen.
Schematics	Diagrams showing how parts of a system are connected and work together.

Sealants	Materials used to close gaps and prevent air, water, or other substances from passing through.
Seasonality	The pattern where products are available only during certain times of the year.
Segregation	Separating items into different groups.
Services	Help or work provided to meet someone's needs, especially in business or technical areas.
Sheens	Glossy or shiny finishes on surfaces.
Shingles	Flat roofing or siding materials laid in overlapping rows.
Slip Resistance	The ability of a surface to prevent slipping.
Soil Fertility	The ability of soil to support plant growth, which can be reduced by erosion.
Solvents	Liquids that can dissolve other substances; commonly used for cleaning or in industrial processes.
Sound Absorption	The process of reducing sound energy through materials.
Spindle	A rotating shaft in a machine that holds the cutting tool.
Standardisation	Making products the same in size, shape, and quality.
Structural elements	Parts of a building that support weight, like beams or columns.
Structural parts	The core building elements, like beams and columns, that give a structure its strength and shape.
Surveying	Measuring land to determine boundaries and features.
Sustainability	Using natural resources in a way that protects the environment for future generations.
Sustainability	Using forest products in a way that protects the forest for future generations.
Sustainability	Using natural resources in a way that protects them for future use.

Sustainability	Using forest products in a way that does not finish or destroy them, so they can last long.
Sustainable energy	Energy from sources that don't run out and are safe for the environment.
Swales	Shallow ditches that help manage rainwater.
Synchronisation	Making different systems or parts work in harmony at the same time.
Target Market	The group of people a business aims to sell its products to.
Telecommunications	Sending and receiving information over long distances, like with phones or the internet.
Thermal insulation	Material that reduces heat transfer between spaces.
Three-dimensional	Having height, width, and depth; not flat.
Timber	Wood that is cut from trees and used for building, furniture, and many other things.
Timelines	Planned schedule showing when tasks should be done.
Tool Kit	A set of tools used for maintaining or repairing machines.
Transmission towers	Tall structures that carry electrical power over long distances.
Trenching	Digging long, narrow holes for pipes or cables.
UV radiation	Invisible rays from the sun that can damage skin, paint, plastics, and fabrics over time.
UV rays	Ultraviolet radiation from the sun, which can damage materials and skin.
UV stabilisers	Special additives used in materials to help them resist damage from UV radiation.
Value Addition	The process of increasing the worth of a product by changing its form, like turning raw bamboo into a bicycle.

Vee-Slide	A guide track shaped like a “V” that allows smooth up-and-down or side-to-side movement of machine parts.
Waste generation	Production of unwanted materials or garbage.
Waste Management	Proper handling and disposal of sawdust, offcuts, and chemicals to reduce pollution.
Waste management	Handling and disposal of waste properly.
Water meter	A device that measures water usage.
Water Resistance	The ability to repel or withstand water penetration.
Waterlogged	Soaked with too much water, often causing problems.
Wear and Tear	The slow damage that happens to machine parts from regular use over time.
Weathering	Natural wear and breakdown of materials due to exposure to the elements.
Wipeable	Describes a surface that’s easy to clean simply by wiping it down, often found in kitchens or healthcare spaces.
Woodturning	The process of shaping wood while it spins on a lathe.
Workstation	A specific area where one part of the production process takes place.

This book is intended to be used for the Year Three Building Construction and Woodwork Technology Senior High School (SHS) Curriculum. It contains information and activities to support teachers to deliver the curriculum in the classroom as well as additional exercises to support learners' self-study and revision. Learners can use the review questions to assess their understanding and explore concepts and additional content in their own time using the extended reading list provided.

All materials can be accessed electronically from the Ministry of Education's Curriculum Microsite.

[Scan the QR Code to visit the website]

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