Ethiopian TVET-System

FACILITY MAINTENANCE

TTLM for Short term Training

Learning Guide

Unit of Competences:

1. **Unit Title: Use Carpentry Hand and Power Tools**

   Unit Code: EIS CRP2 02 1118

2. **Unit Title: Produce Hand Made Timber Joints**

   Unit Code: IND FMK1 05 0912

3. **Unit Title: Install and Replace Windows and Doors**

   Unit Code: EIS CRP2 08 1118

4. **Unit Title: Maintain Non-structural and Structural Carpentry Components**

   Unit Code: EIS CRP2 09 1118

Module Title: Carpentry work

LG Code:

TTLM Code:

Introduction

During their working life, most carpenters, plumbers, electricians or any other technical persons will spend a great deal of their time repairing and/or maintaining various items associated with buildings and their contents. Firms that specialize in this type of work tend to employ craftsmen who are flexible, in the sense that they are familiar or up-to-date with and capable of carrying out basic jobs outside their own specialist area. For example, a carpenter and joiner may be expected to glaze or re-glaze a window, or use a trowel and float to do some patchwork on a plastered wall or concrete floor. The ability to lay or renew broken tiles or slates may also be a requirement.

A sound knowledge of building construction is essential for all skilled operatives engaged on this type of work. Certain items of hardware are expected to be replaced periodically, due to wear through use; failure to provide and carry out a general maintenance programme **(**for example, to ensure that the building remains watertight and those protective coatings to any part of the building are regularly re-applied, etc.**)** will lead to deterioration and eventual failure of many other building materials.

Hence, facility maintenance as a field of work is designed to give short term training for any graduates of Building construction technology from Ethiopian TVET colleges. Therefore after the training you will be able to maintain any of the defected parts with respect to carpentry work, water supply and drainage systems, electrical installation systems or whatever.

In this learning guide unit of competences from level two and above **(**of building construction technology occupations**)** are selectively included with the understanding that you have taken the training on Basic Building Construction Level-I. Trained personnel in facility maintenance can work as a general maintenance worker in hotels, malls, house to house service for residences, and the like.

It is hoped that this training will significantly contribute for job creation, since this field of work as an occupation is not yet formulated in our country.

This short term training learning guide is prepared for the competency titles mentioned on the cover page i.e

- Learning guide **1** for Use Carpentry Hand and Power Tools
- Learning guide **2** for Produce Hand Made Timber Joints
- Learning guide **3** for Install and Replace Windows and Doors and Maintain Non-structural and Structural Carpentry Components

Instruction Sheet	All Learning Guides

The learning guides in this package are developed to provide you the necessary information regarding the following content coverage and topics but not limited to –

- Hand tools
- Portable Power tools
- Tools sharpening
- Tools maintenance
- Wood Joints
- Installation of wall frames
- Installation of door and window frames
- Installation of Doors and Windows
- Installation of door and window casings
- Installation of Door locks
- Door and window Accessories
- Cut and fix window glass

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- *Identify and properly use woodworking hand tools.*
- *Identify and properly use portable woodworking power tools.*
- *Make wooden joints to maintain broken parts.*
- *Identify the different kinds of carpentry accessories.*
- *Maintain wooden parts of buildings when the need arises.*
- *Use the knowledge and skills contained in this learning guides as foundation to future career development.*

Learning Activities

1. Read the specific objectives of this Learning Guide above.
2. Read through the Learning Guide carefully. It is divided into sections which cover most of the skills and knowledge that you need.
3. Read Information Sheets and complete the Self-Check at the end of each section to check your progress
4. Read and make sure to Practice the activities in the Operation Sheets. Ask your trainer to show you the correct way to do things or talk to more experienced person for guidance.
5. Do the "LAP test" and show to experienced individuals. You my get constructive suggestions. If the output of your work is not satisfactory, do it again to improve the result.

After completing the training it is expected that you will be able to maintain wooden parts of a building and furniture installed in it with long lasting strength, attractive finish and low cost. In addition it is hoped that you will have the attitude of doing jobs for excellence with efficient utilization of resources, take responsibility for the work you are assigned, and do your job with honesty and loyalty.

Important advice	Learning the techniques

Woodworking techniques are best developed by using a **practical**, **methodical** approach. This will encourage you to learn how the tools and wood come together. There is plenty of material available to help you with this. As well as using practical manuals (such as this one), there are instructional DVDs, and the internet. Ideally, you could back this up (support) with some hands-on instruction by attending a college course or a workshop or, in a perfect world, work alongside an experienced woodworker who can show you first-hand how best to work.

Whatever combination of instructions you choose, you will only really **improve by constant practice**. Once you understand the anatomy of a technique, such as how a carefully maintained tool can be used to make a predictable mark or cut, then the only way to perfect that technique is to **practice it repeatedly**.

WORKING ACCURATELY

Accurate woodworking relies on two main considerations: ***the position of the cutting lines you've marked*** and ***the position of your tool in relation to that line***. While this may sound obvious, if your line is not exact, or your cut is a fraction over or under the line, you will end up with a sloppy joint, or a component part that is less than perfect.

To avoid this, mark out all cutting lines with extreme care and using appropriate marking tool. Once you have made a perfect mark, and you have established which side of the cutting line will go to waste, then you can run the cutting tool to the waste side of the cutting line with confident knowledge that your cut cannot go wrong.

In addition, you have to know that, the success of any woodworking technique is dependent on the quality of the tools that you are using. For good, accurate work, ensure that your tools are in good condition before you begin. Here you have to remember one saying- ***"A lazy carpenter blames his hammer".*** If there are mistakes in your work you should not blame the hammer or plane or any other tool, it is you who did the mistake.

We are taking all these precautionary measures; because once a given wood is cut, it cannot be returned back to its original shape or size. Therefore "***Measure ten times and cut once".***

BEFORE YOU BEGIN

When working on wood for the first time, you are likely to encounter various problems and difficulties. There are a few basic rules that you can bear in mind to help keep any setbacks to a minimum:

- ***Read it through***—make sure you read through every step of the instructions in full before you start working on the wood. It is important to know what you are trying to achieve; otherwise, you may not notice if you have done something wrong along the way.

- ***Equipment***—collect all the equipment you'll need in advance of starting a project (*this is listed in the Tools and Materials panel on each project*). You should not get halfway through and realize you don't have a vital tool.
- ***Patience***—learning to craft and shape wood can be time-consuming and at times tricky, but don't let this put you off. Patient practice is the only way to build up your skills and efficiency.
- ***Off-cuts***—it is more than likely that your skills will take time to hone **(**sharpen**)** your tools, so make sure that you practices on off-cuts (waste pieces) until you feel fully confident. Mistakes on large pieces of wood can be expensive.

Learning Guide #1

Unit of Competences:

Unit Title: Use Carpentry Hand and Power Tools

Unit Code: EIS CRP2 02 1118

Information Sheet-1	1A. Carpentry Hand Tools

Introduction: Hand tools are non-powered instruments used for construction. Unlike power tools, they are not driven by electrical, fuel, or pneumatic (air) power. They are driven by muscle and controlled by hand. Proper use of these tools will help to produce quality products and prevent accidents.

1. Steel rules: Used for measuring. We can buy one with a *combination-square head* and to multiply its value at least threefold by adding the ability to check and mark perfect 90° and 45° angles.

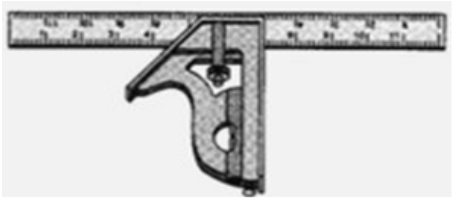


Fig 1 Combination square

2. Combination Square: Is used for checking 45^0& 90^0 angles, vertical & horizontal levelness & also depth.

3. Zigzag rule (folding rule): is made up of hardwood, steel, or aluminum sections, each measuring 6 to 8 inch. The sections are connected by spring joints that unfold for measuring distances. These folding rules are usually from 2 to 6 feet long.

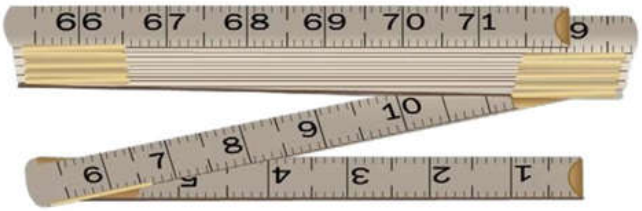


Fig 2 Folding rule

4. Tape measure (Flexible steel rule):

Instrument for determining length made up of a graduated, flexible tape of variable length that rolls up inside a case.

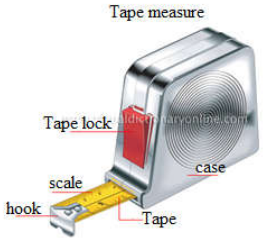


Fig 3 Tape measure

5. Try square:

it is used for testing the squares of surfaces and edges of -pieces, outside and inside corners of joints, and for marking lines at right-angles to a given surface or edge.

Fig 4 Try-square

5. Bevel square (T-bevel):

Instrument whose movable arms are used for measuring or for marking an angle.

6. Framing square

Instrument, usually graduated, used for marking right angles and to check that joints and cuts are perpendicular.

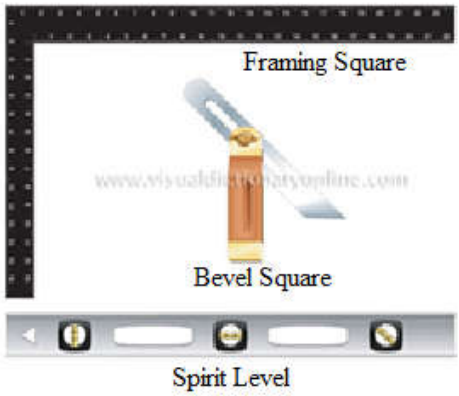


Fig 5

7. Spirit level

Instrument fitted with tubes containing a liquid and an air bubble that, when placed between two points of reference, shows whether a surface is level, vertical or at 45°.

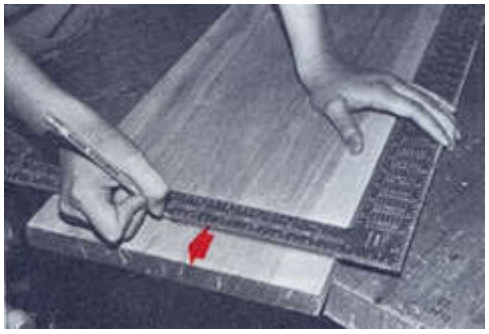


Fig 6 Squaring a line across the end of a board

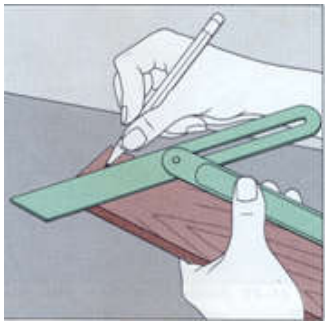


Fig 7 Marking a chamfer with a T-bevel

8. Marking Gauge:

A marking gauge is used in woodworking to mark out lines for cutting or other purposes. The main purpose is to scribe a line parallel to a reference edge.

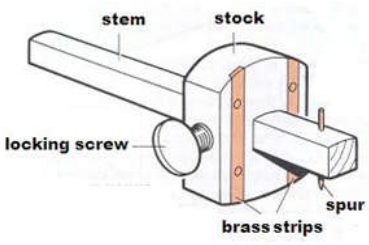


Fig 8 Marking gauge

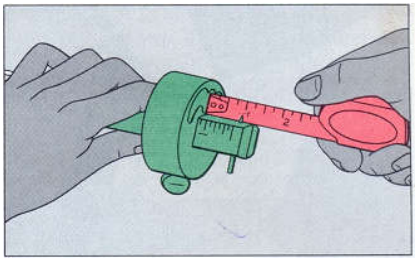


Fig 9 Adjusting depth of a marking gauge

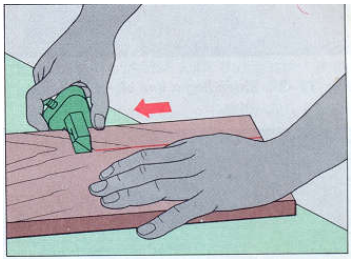


Fig 10 Marking a line with marking gauge

SAWS:

Saw blades have serrated edges called "teeth" along one side, which are bent at an angle and set to alternate sides. When cutting through wood, the teeth create a slot, or "kerf," that is wider than the blade. This helps the blade move freely through the wood without getting stuck. There are many different types of saws, each designed for specific woodworking tasks.

9. Panel saws

Saw blades have serrated edges called "teeth" along one side, which are bent at an angle and set to alternate sides. When cutting through wood, the teeth create a slot, or "kerf," that is wider than the blade. This helps the blade move freely through the wood without getting stuck. There are many different types of saws, each designed for specific woodworking tasks. Western (or European) saws cut on the "push" stroke, whereas Japanese saws (see opposite) cut on the "pull" stroke.

Panel saws are among the most commonly used of all saws. They have a long, flexible blade and are ideal for cutting boards and panels, as well as for **ripping** or **cross-cutting** solid timber (*see below*). Good-quality panel saws have blades that are ground to a taper to ease sawing. The panel saw is used for cross-cutting or ripping purpose.

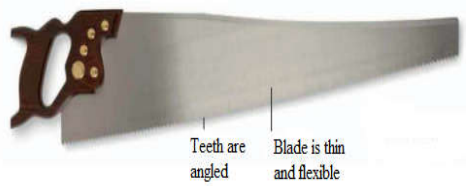


Fig 11 Panel saw

Fig 12 Cross-cutting a board held in clamp

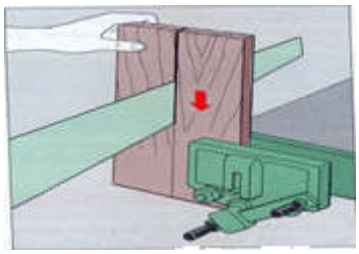


Fig 13 Ripping a board held in vice

- ***Cross-cutting*** is cutting across the grain of the wood (reducing length).
- ***Ripping*** is cutting along the grain of the wood (reducing width).

10. Back saws

Used primarily for cutting tenons, Back saw gets its name from the piece of folded, or cast, metal that runs along its back edge, supporting the blade. This heavy metal spine keeps the saw steady when

cutting through wood. Back saws have smaller teeth than panel saws, which results in a finer cut but at a slower pace.

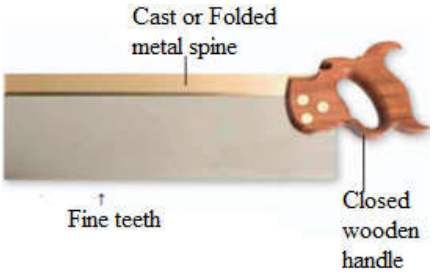


Fig 14 A back saw

11. Coping saws

In order to perform tasks, such as cutting curves\or removing waste from joints, a coping saw is very important. The blade is thin and narrow, which allows it to be turned easily.

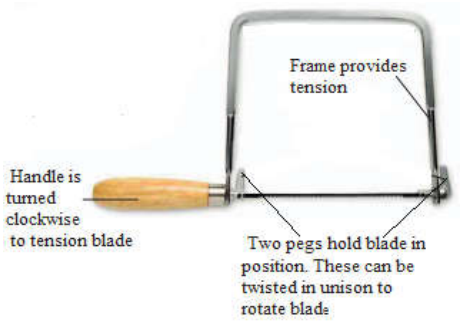


Fig 15 A coping saw

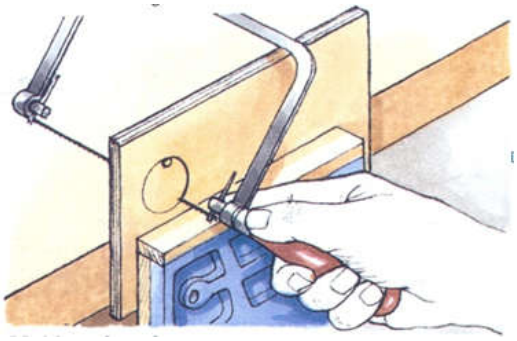


Fig 16 Cutting a curve with a coping saw

12.Key hole Saw

A keyhole saw, or compass saw, has a small pointed blade and a wood or plastic handle. It is useful for cutting holes in softer woods or in drywall, such as cutting a hole in a wall for a new electric switch. Most keyhole saws have a single handle to which various blades can be fitted.

Fig 17 A keyhole saw

Fig 18 Cutting a hole

13.Hacksaw

Frame handsaw for sawing metal of varying thicknesses.

Fig 19 A Hack saw

14.Hand plane

Hand tool with a cutting blade, intended mainly for planing a wood surface or to give it a shape (e.g., beveled, chamfered). There are different kinds but here is given the typical plane.

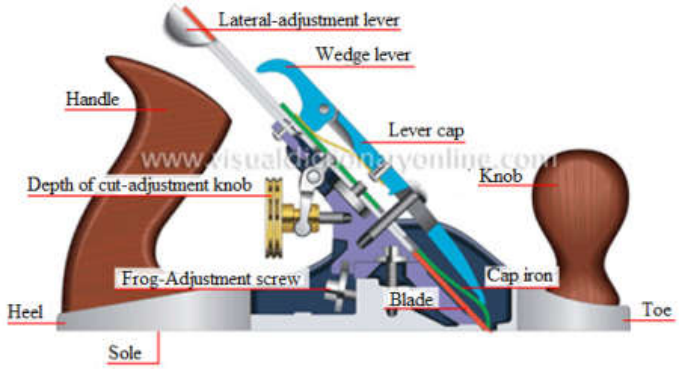


Fig 20 A hand plane

15.Rasp

A hand tool made up of a metal blade having a curved tooth, can quickly rough out wood, metal or plastic. In addition there are different types of files used for smoothing edges and shapes where other cutting tools cannot easily be used. Their types are Round, square, half-round, Triangular and flat, used for smoothing surfaces.

Fig 21 Rasp file

16.File cleaner

The file cleaner, or file card has steel bristles that are used for cleaning the teeth on a file.

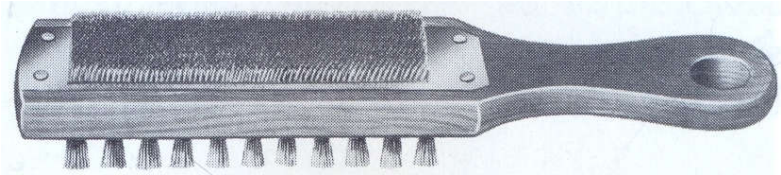


Fig 22 A file card

17. Wood chisel

Hand tool with a metal blade whose end is beveled for woodworking. In use, the chisel is forced into the material to cut the material. The driving force may be manually applied or applied using a mallet or hammer. There are different types of chisels.

Fig 23 A wood chisel

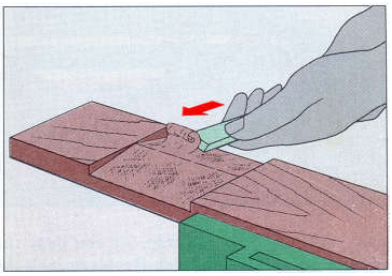


Fig 23 Cutting with a wood chisel

18. Hammer:

The most common uses are for driving nails, fitting parts, and breaking up objects. Hammers are often designed for a specific purpose, and vary widely in their shape and structure. Usual features are a handle and a head, with most of the weight in the head.

Fig 24 A claw hammer

19. Ladders and stepladders

Movable devices of wood or metal, composed of rungs or steps and used to reach relatively high areas.

Fig 25 Ladders and step ladders

20. C-clamp

Portable tool with a C-shaped frame, used for keeping objects from moving while working on them.

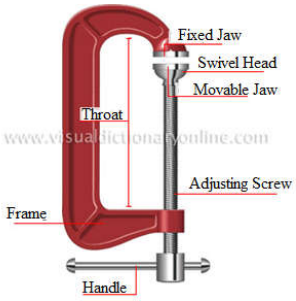


Fig 26 A C-clamp

21. Bar clamp

- **Bar c**lamps are used for assembly of large flat components while gluing, to hold and fix the parts being assembled together while the glue is setting.
- Long metal clamp opening ranges from 45cm-195cm.

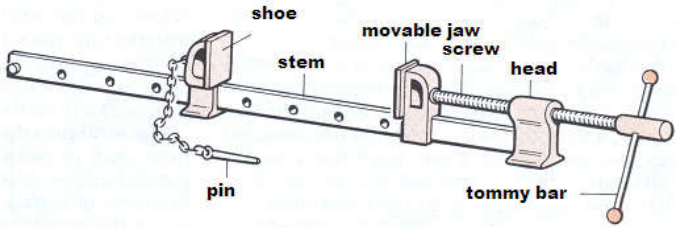


Fig 27 A bar clamp

Fig 28 Timber clamped with a bar clamp

22. Vice:

Press with two jaws; it is attached to a work table and used for clamping objects.

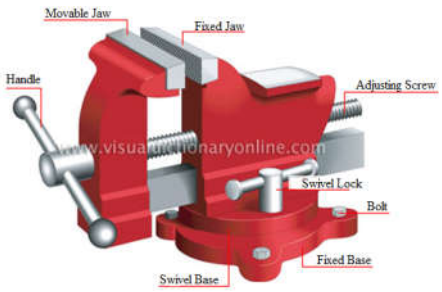


Fig 29 A bench vice

23. Pincer

Pincer is used to pull nails and to cut wire or nails.

Fig 30 A pincer

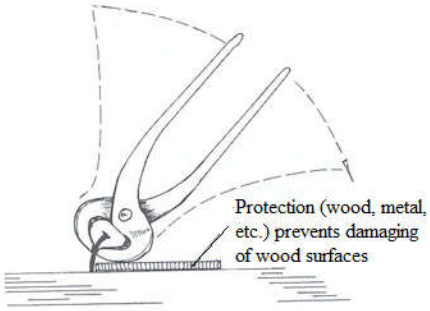


Fig 31 How a pincer works

24. Screw Driver:

- Used for screwing (installing) and unscrewing (removing) screws.
- It can be classified as *flat/slotted screwdriver*, *Phillips screwdriver*, *Pozidriv Screwdriver*, *Robertson Screwdriver*, *Torx Screwdriver* and *Hex Screwdriver or Hexagon Screwdriver*

Fig. 32 Screw drivers and screw heads.

25. Ratchet screw driver:

-It has a built-in gear which can be set in to three different positions by means of a ratchet shifter.

-In the middle position the handle and the blade are a whole, just like on ordinary screw driver.

-In the forward position of the ratchet, the screw driver is used to turn a screw clock wise (fastening).

-In back ward position of the ratchet, the screw driver is used to turn a screw anti clock wise (Unscrewing)

Fig 33 A ratchet screwdriver with its interchangeable blades.

26. Nail Set:

Is a piece of steel rod having one end turned to a taper. It is used in conjunction with a hammer for driving the heads of nails below the surface of a job. There are different sizes to fit different sizes of nail.

Fig 34 A Nail set

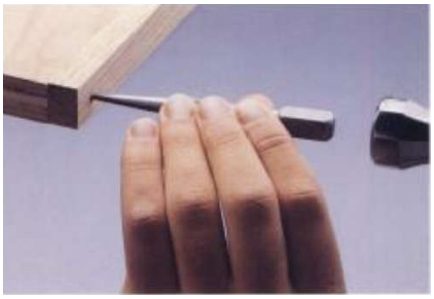


Fig 35 Setting in a nail with a nail set

27. Hand drill:

The hand drill is used for drilling holes $^1/_4$ in, (6mm) or less across. Twist drills or drill bits are inserted into the jaws of the drill to do the job.

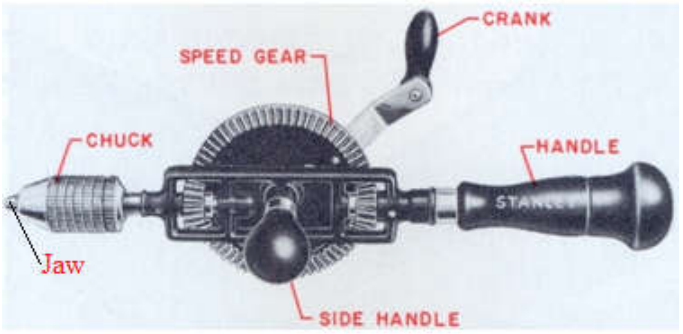


Fig 36 A hand drill

28. Drill Bits

Twist drills are used to bore holes for dowels, screws, bolts, and other wood fasteners. The twist drills that can be used for drilling both wood and metal have sizes from 1.4mm to 12.7mm; the size going up by 0.4mm.

Fig 37 Straight shank drill bit

Fig 38 Twist drill

29. Brace:

- In boring holes, the brace holds and turns auger bits. A brace can also be used to hold and turn other kinds of bits, drills, counter sinks, and screw driver bits.
- The size of the brace is the size of its sweep or swing that is the diameter of the circle that the handle makes while it is moving.

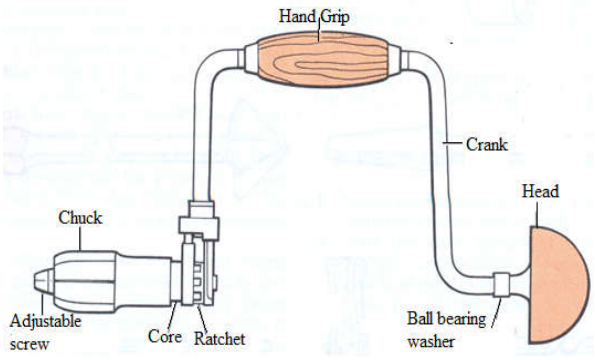


Fig 39 A Brace

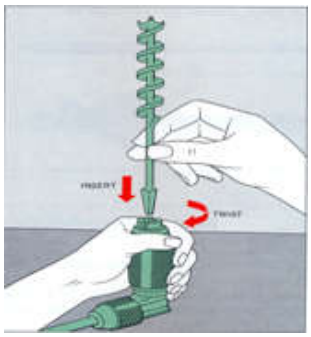


Fig 40 Putting an auger bit into the brace chuck vertically

Fig 41 boring a hole

30. Auger Bit:

Auger bits are inserted in the adjustable screw of a brace and bore holes. The most common types of auger bits are the following.

Fig 42 Solid center auger bit

Fig 43 Single-spur car auger bit

31. Counter sink bits

It is useful to make the top part of a hole bigger, giving it a cone shape with angle of about 82°. In this way, the head of a screw with a flat head will be flush with surface of the wood.

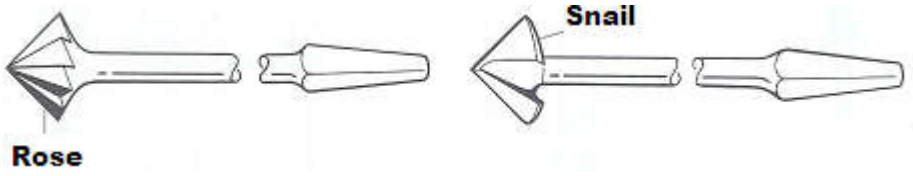


Fig 44 Countersink bit

32. Prying Tool

Prying tools are essential part of any carpenter's tool arsenal, because many carpentry projects start with the removal of existing materials. With these tools you can often remove nails without damaging the lumber, so that it can be used again.

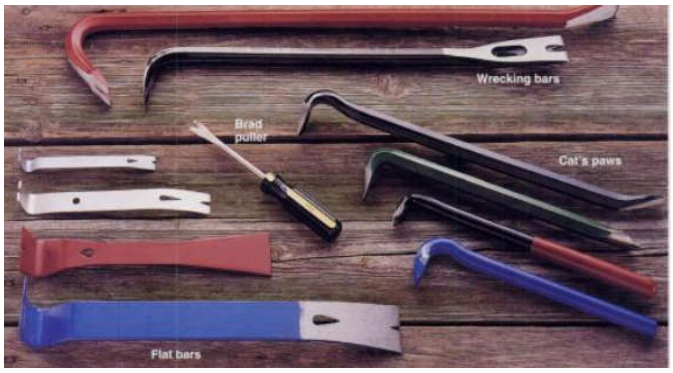


Fig 45 Prying tools

Fig 46 Prying

33. Sawhorse

A s**awhorse** is a beam with four legs used to support a board or plank for sawing.

A pair of **sawhorses** can support a plank (piece of wood), forming a scaffold.

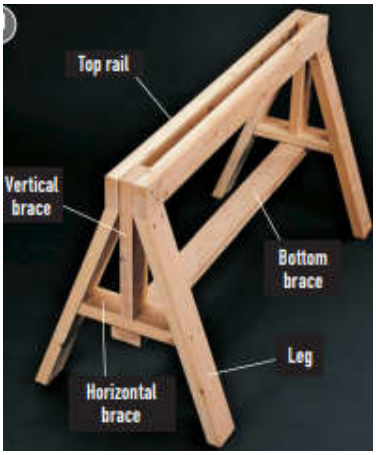


Fig 47 A sawhorse

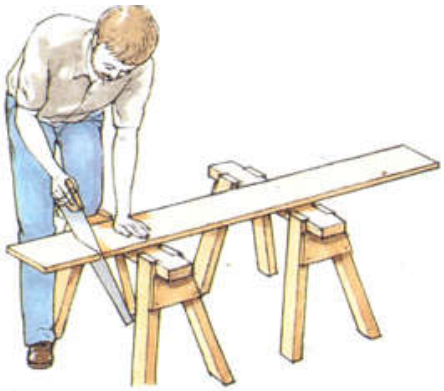


Fig 48 Crosscutting timber on a sawhorse

34. Bench grinder

It is fitted to a bench top and can be used to keep tools sharp or to grind and shape material with the use of spinning abrasive wheels. A dual wheel **grinder** has two **grinding** wheels with different abrasive grades allowing multiple **grinding** or sharpening applications from the one tool.

Fig 49 Using a bench grinder

35. Oilstone

A block of fine-grained stone, usually oiled, for putting the final edge on certain cutting tools like chisel, plane iron, etc. by abrasion. Diamond Stones, Water Stones, Slip Stones and other similar materials are also used for the same purpose. But the oilstone is the most common one in our country.

Fig 50 Oilstone

Self-check - 1	Written Test

Directions: Answer all the questions listed below.

1. List down at least 5 tools used for checking.
2. What is the tool used to scribe a line parallel to the edge of a piece of wood?
3. Name a tool used to hold the timber until we finish a task, like cutting or drilling, etc.
4. A saw with thin narrow blade and used to cut curves\or remove waste from joints is ____
5. A tool used with a hammer to drive the head of a nail below the surface of a job is _____

Note: **Satisfactory rating is 3 points and**
Unsatisfactory is below 3 points

Answer Sheet

Name _____ **Date** _____

Information Sheet-2	1B. Operate Portable Power tools

Portable power tools are light in weight, easily carried, and are held in the hands during operation. The use of portable power tools in the workshop and on site is ever-increasing. The main advantages of these tools are work faster with increased productivity, less cutting and maintenance cost. It includes;

1. Portable circular saw

It is a power-driven rotary cutting tool, which is principally used for cutting boards and for making angular cuts. Its size is determined by the diameter of the largest blade it will take. Most carpenters prefer a 7 or 8 in. diameter saw blade. The depth of cut is adjusted by raising or lowering the position of the base or shoe. The portable electric saw may be used to make cuts in assembled work. For example, flooring and roofing boards are often nailed into place before ends are trimmed.

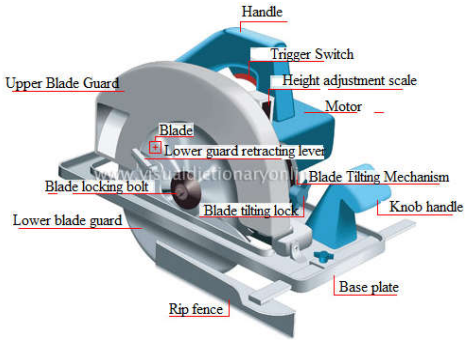


Fig 51 portable circular saw

Fig 52 portable circular saw blade

Fig 53 Using portable circular saw

2. Portable electric plane

It is a power-driven rotary cutting tool, used for planning wooden surfaces and edges. The depth of cut is adjusted by raising or lowering the front shoe. The rear shoe (main bed) must be kept level with the cutting edge of the cutter head. The power plane is equipped with a fence that is adjustable for planning bevels and chamfers. For surfacing operations, it is removed.

Fig 54 A portable sander

Fig 55 Using a portable sander

3. Portable power drill

It is a motorized rotary driving tool, used for drilling purpose. It comes in a wide range of types and sizes. The size is determined by the chuck capacity. Cordless portable drills are handy for many jobs. Power is supplied by a small nickel-cadmium battery that can be recharged. Such drills are used for general maintenance work and on production jobs where there are no power lines.

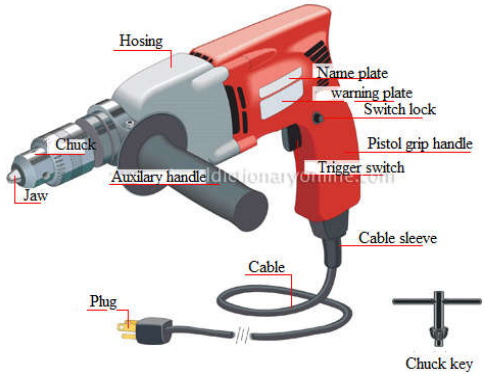


Fig 56 Portable electric drill

Fig 57 Cordless portable drills

4. Portable Power Jigsaw

Powered jig saws have reciprocating blade, which moves up and down at high speed to cut timber or other material. A range of interchangeable saw blades are available.

Jig saws are mainly used for cutting slots & curves but can also be used for straight cutting, usually with the aid of guide attachment or fence to aid accuracy. Care must be taken to select the correct blade and speed setting. Example fast for wood, slow for metal.

Cutting can start at one edge of the material or, if cutting slots or holes, the saw blade can be inserted through a pre-drilled hole in the material to be removed.

Fig. 58 Portable jigsaws

Fig. 59 Jigsaw blades

5. Portable power router

It is a power driven shaping tool, used to cut irregular shapes and for producing a variety of patterned work pieces. When they are equipped with special guides, they can be used to cut dados, grooves, mortises, and dovetail joints.

Fig 60 Portable power router

6. Portable sander

It is a power driven tool, used for sanding (smoothing) wooden surfaces. It includes three basic types; Belt, Disc and Finish portable sander.

The size of the belt and disc sander is determined by the width of the belt and the diameter of the disc respectively. Portable finishing sanders are used for final sanding where only a small amount of material needs to be removed. They are also used for cutting down and rubbing finishing coats.

Fig. 61 Portable Belt sander

Using the right tools for the job:

You should avoid the temptation to simply browse a manufacturer's catalogue and order a vast range of tools. When starting out in woodworking it is best to carefully consider your first project—its size and shape, the materials and techniques required— and then visit a quality tool supplier and select the minimum number of tools necessary to complete the job. Once you start work, you may of course discover that you need more tools— for example a different plane or another clamp, but at least these extra purchases will be guided by your actual needs.

In this TTLM only a few tools and equipment which are most commonly used in carpentry are discussed. Therefore you (the trainee) should read more, practice more and consult experienced individuals for your further knowledge and usage of hand and power tools.

Self-check - 2	Written test

Directions: Answer all questions listed below. (5 points each)

1. Explain the difference between portable power circular saw and the portable power Jig saw.
2. What is the functional difference between the portable power plane and the portable power sander?

Note: **Satisfactory rating is 5 points and**

Unsatisfactory is below 5 points

Answer Sheet

Name _____ **Date** _____

Information sheet 3	1C. Tools Maintenance

Introduction

Maintenance can be defined as working on something to keep it in a functioning and safe state and preserving it from failure or decline.

The objectives of maintenance are the following:-

- Optimizing resources utilization.
- Reducing downtime.
- Improving spares stock control
- Maximizing production at lowest cost and highest quality and safety standards.
- Reducing breakdowns and emergency shutdowns.

❖ *The main purpose of regular maintenance is to ensure that all equipment required for production is operating at 100% efficiency at all times.*

- Equipment breaks down leads to inevitable loss of production.
- The cost of regular maintenance is very small when it is compared to the cost of a major breakdown at which time there is no production.

❖ Maintenance inspections should conducted at recommended service intervals for the benefit of :

- Reduced repair costs due to preventative maintenance;
- Ensuring optimum performance at all times
- Higher resale value for well-maintained equipment
- Minimizing problems.

Types of maintenance

Maintenance can be classified as:-

A) preventive maintenance and

B) Corrective maintenance

A. Preventive maintenance: - **Preventive** or **proactive** maintenance is carried out to keep something functional. This type of activity is usually **planned** and **scheduled**. It is a step taken to keep every equipment in a better condition and not wait until it is in a direct need of maintenance.

❖ Some of the jobs done in preventive maintenance are:-

- programmed replacements of parts
- overhauls
- lubrication

- oil change and
- cleaning

❖ You can monitor the condition of your tools and equipment in two ways:

Subjective condition monitoring: - when the monitoring is done by the senses such as Listen, look, touch, taste and smell to estimate the condition of the tool or equipment. The results achieved are very much dependent on the worker. Here practice and experience plays a great role.

Objective condition monitoring**:** - this is when the condition of equipment is measured in some other way than using the senses.

The benefits of *preventive Maintenance* are many. Here is a list of few such benefits:

❖ It increases the efficiency and speed of your equipment. .

❖ It saves you from spending too much when the tools break down completely and requires a big time repair or a replacement.

❖ It also saves your time since you need not face the break down when you need the tools the most and then spend time to get the tools back in shape.

❖ It also helps to save money. Preventive maintenance would cost lesser than repairs and replacement.

❖ It also ensures the safety of the person who is working with the tools. If the tools are not in a proper condition it might also lead to a major accident which is not desirable at all.

B.Corrective maintenance: - **Corrective** or **reactive maintenance** is repairing something to get it working again. This is an **unscheduled**, **unplanned task**, usually associated with greater hazards and higher risk levels. It implies that repairs are made after the tools are out of order.

❖ Corrective maintenance represents the actions to establish the required state of tools or equipment. It focuses on the improvement of components and the elimination of weak points.

Information Sheet 4	1D. Sharpening Hand Tools

- All hand tools need to be sharpened regularly for good performance. It cannot be avoided and you cannot pay someone else to do it for you.
- Sharpening is simple and anyone can do it. It is only the sea of conflicting information that exists about "the right way to sharpen" that makes sharpening seem difficult.
- If you've never enjoyed using a hand plane or chisel, or if you view them as tiresome (boring), you've probably never used a truly sharp tool.
- A bench grinder does not create a sharp tool.
- "Sharp" is to polished surfaces meeting at a 0° radius. Therefore, tools get dull because the cutting edge is rounded over (blunted) or scratches exist (not a polished surface).

What to Consider When Sharpening

i. **Bevel Angle:** General term for the angle between the cutting edge and the back of the tool. Usually consists of 2 if not 3 actual angles. Not all tools are sharpened at the same angle, so before you begin to sharpen, decide what angle you are shooting for.

ii. **Polish of the Cutting Edge:** Finer and finer grit sharpening media hones a finer and finer polish on the tool. All tools need to be honed to a reasonably high finish.

iii. **Blade Geometry:** Many tools require a straight, square edge (chisels, some plane blades), other benefit from a curved blade (smoothing plane blades and others based on preference).

When these 3 properties are understood, sharpening is simple.

Bevel Angle

- **Primary Bevel:** Main angle the tool is sharpened at. If someone says "this tool is sharpened at 25°" they are typically referring to the primary bevel. This surface is not honed/polished.
- **Secondary/Micro Bevel:** A slightly steeper angle than the primary bevel created at the tip of the tool. This is taken to a high polish (honed).
- **Back Bevel:** Can be used on bevel-down planes, but in general this is not necessary or even desirable. (see next page for example)

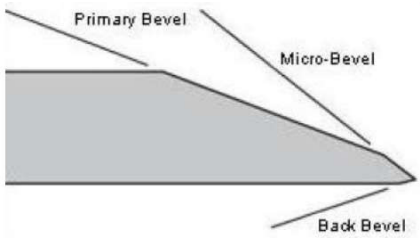


Fig. 62 Types of bevels

How Bevel Angles Affect the Cut

- **Bevel-Up vs Bevel-Down:** Direction the bevel faces when a tool is cutting wood. Bench planes are bevel-down, block planes are up.
- **Effective Cutting Angle:** Total angle at which the cutting edge is presented to the wood.

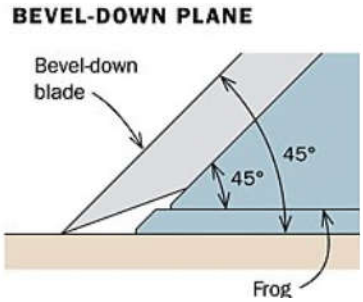


Fig 63 The cutting angle is determined by the frog angle

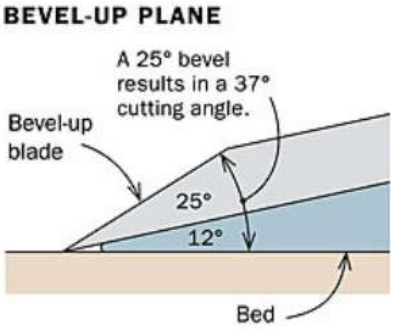


Fig 64 The cutting angle is determined by the bed angle and the bevel angle

***Bevel-down blade:** is where a back-bevel can increase the effective cutting angle on a bevel-down tool, helping to reduce tear out. The other option is to install a high angle frog assembly

- There are three sharpening operations that must be performed on all chisels and plane irons that are new to you.

  1st You must polish the flat backside (sometimes called the "cutting face") of the tool.

  2nd You grind the cutting bevel.

  3rd Finally you hone and polish a small part of that cutting bevel (micro bevel), which most people call the "secondary bevel."

Sharpening with a grinder

- It removes material rapidly, too rapid for general hand tool sharpening.
- Grinders are useful for shaping a blade, re-establishing a primary bevel or repairing a chipped blade, much less useful for day-to-day sharpening.
- *If a grinder is to be used, do not grind to the tip*. The metal is too thin and will quickly heat up, removing the tool's hardness and elasticity and damage the steel. Stop grinding at 1/8" before the edge and cool the tool often during the grinding process.
- Stopping the grind prior to the cutting edge is not a problem as the grinder is only creating your primary bevel; you will hone the tip which is the micro-bevel so *grinding right to the cutting edge is unnecessary.*

Operation Sheet 1	Sharpening a plane iron

OPERATION TITLE: Sharpening a plane iron

PURPOSE: To make leveled and smooth wood surfaces.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and complete set of tools.

Equipment tools and materials: all personal protective equipment, Bench grinder, Oilstone [coarse, medium (optional) and fine], Honing guide,

Procedure:

1. Start with the back of the tool. If you don't polish the backside of your newly acquired chisels and plane irons, your cutting edges will always be jagged (uneven) and easily dulled.

After the first polishing of the back side, you will only need to hone the bevel, so the first time you sharpen a new tool should be the most time consuming and labor-intensive.

Fig 65 This is a process you'll only have to do once.

2. With the back prepared, clamp your tool in a honing guide at the desired angle put the tool in your honing guide and adjust it until the cutting bevel is flat on your stone. Eyeball it (have a good look at it) first. After a couple passes on the stone you'll know if you're off or not.

Fig 66 A plane iron clamped in a honing guide

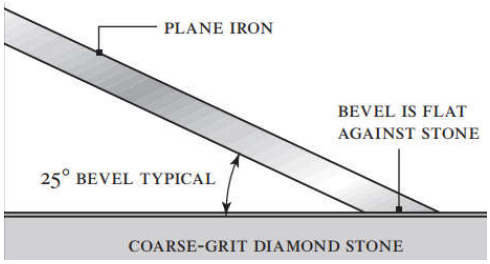


Fig 67 Correct placement of the plane iron on the honing stone

3. Hone the primary bevel on your course grit stone. It should **not** take long. Check it repeatedly to see that it is correctly done.

Move your hand back and forth pressing the plane iron down.

Fig 68 Flat-grinding your cutting bevel

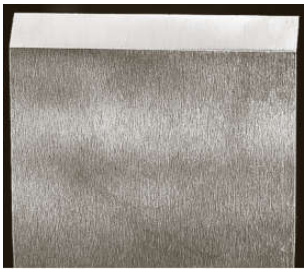


Fig 69 when you finish grinding, this is what your edge should look like

4. Increase the bevel angle by 2°-3° and hone your micro-bevel first on a medium then on a fine stone or directly on a fine stone if no medium stone is available.
5. In between of the honing process turn the tool over and remove the burr (wire edge) from the backside by rubbing it a couple times over the fine oilstone.

Fig 70 Removing the burr

6. Remove the tool from your honing guide, wipe it down with a little oil to prevent rusting and go to work on some end grain. The tool should slice through the wood with little effort.

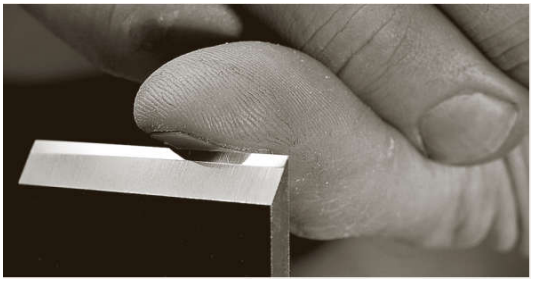


Fig 71 After honing the tool on the fine oilstone, this is what the secondary bevel should look like

Re-Sharpening

• Each time the micro-bevel is honed it moves farther up the primary bevel, increasing the amount of material to polish. After several cycles, you should re-sharpen the plane iron on a bench Grinder and perform the honing process again following the above procedure.

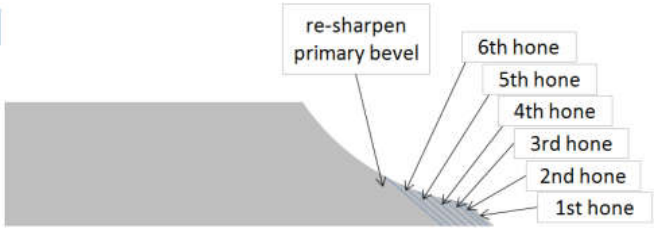


Fig 72 How long honing should go on before the next grinding of the plane iron on the bench grinder is done.

Note: one advantage of the hollow created by a grinder is the increased number of polishing cycles you can go through before re-establishing the primary bevel (see Fig 72).

PRECAUTIONS:

- Honing angle should be repeatedly checked.
- If the oilstone is not flat, splash oil or kerosene on it and brush it with a flat iron till it becomes flat.

QUALITY CRITERIA:

- ❖ Sharpness of the resulting plane iron. It should cut paper easily with shearing (side ways) cut.

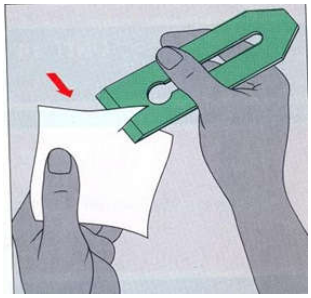


Fig 73 Cutting paper with a shearing stroke.

Operation Sheet 2	Practice Planing

OPERATION TITLE: Squaring up a stock

PURPOSE: To plane all face and edges of a piece of wood to the extent that each corner will be 90^0 when tested (checked with) a try-square.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: all personal protective equipment, tape measure, Try-square, Steel rule, Jack plane, Pencil, clamps or bench vice.

Procedure:

1st. Rough sizing:

Work out the most efficient way to cut the components needed from the rough-sawn boards that are available. Mark out the dimensions (size) with a tape measure, straight edge, and carpenter's pencil, avoiding defects. Keep in mind that some components should have matching grain. As a general rule when cutting short pieces, cross-cut first and rip second.

2nd. The piece is first planed flat on one face (across the width). Assess where the high points are and which direction to plane in order to follow the direction of the grain while planing to produce a smooth surface. If the grain tears, try working from the opposite end. Keep the pressure on the front of the plane as you begin a stroke, then transfer the pressure to the back of the plane as you complete the stroke. This avoids rounding over at the ends.

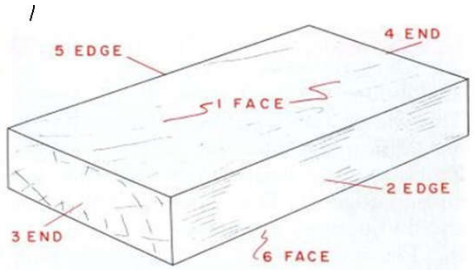


Fig 74 the steps in planing a board

A long, straight edge such as a metal ruler (or steel rule) turned on its edge is used to assess the flatness of the face side from end to end in various positions, both straight and diagonally. Sighting along the ruler with your eyes at its level will help you spot defects.

Fig 75 Place the wood in the vise and start the 1st face side

Fig 76 A straight edge such as a metal ruler turned On its edge is used to assess the flatness

Fig 77 Complete planing the planing

3rd. Plane an adjacent surface (the edge), ensuring that it is 90 degrees (with a try-square) to the face.

Fig 78 Check the squareness

Fig 79 Mark any location

Fig 80 Plane the 1st edge

Fig 81 Use a metal ruler to check the end-to-end flatness

Fig 82 Put a mark when the edge is flat

4th Plane the first End

Check squareness with the 1st face and the 1st edge.

5th Plane the second End

Check squareness with the 1st face and the 1st edge.

**While planing the end sides fix a support block with the work piece, to avoid splitting of the piece.*

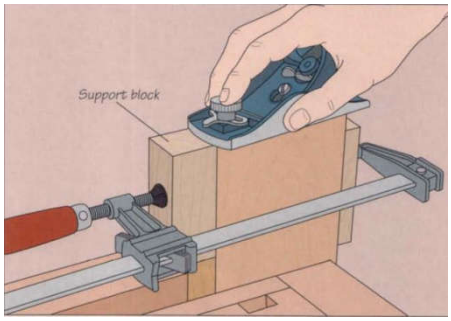


Fig 83 A piece of block used to protect end grain

6th Plane the second edge

Check squareness with the 1st face and the two ends.

7th Marking the thickness

Fig 84 Measure with a ruler and then set the marking gauge to the desired thickness.

Fig 85 Place the marking gauge against the face side and score the thickness along the edge.

Fig 86 Use the marking gauge to score the thickness along the other edge and both ends of the piece

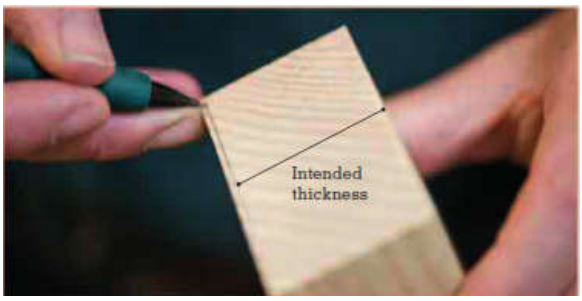


Fig 87 If necessary, make the line easier to see.

8th. Cutting the thickness

Plane the second face and check its squareness with the surfaces finished in the previous steps. Continue planing until you have reached the scored line denoting the thickness and the surface is smooth.

PRECAUTIONS:

- Observe safety in the work place.
- Use the right tool for the right work.
- Use appropriate OHS materials

QUALITY CRITERIA:

- Leveled surface when checked with a straight edge (or steel rule).
- Corners form 90^0 when checked with a try-square.
- The resulting surface should be smooth.

Learning Guide # 2

Unit of Competences:

Unit Title: Produce Hand Made Timber Joints

Unit Code: IND FMK1 05 0912

Information Sheet-5	2A. Construct Mechanical Wood Joints

Introduction

A joint is the place at which two separate pieces of wood are connected or attached. Its purpose is to changing direction, increase length, width or thickness of wooden pieces. Wood joints are used in everything from furniture making to home building. Different jobs require different wood joint.

There are two common ways to create wood joints: **mechanical** and **non-mechanical**.

- Mechanical wood joints require the use of reinforcements like nails, screws or other non-wood elements to hold the wood pieces together. Examples are **Butt, Rabbet, lap and miter joints**.
- Non-mechanical wood joints use only wood with adhesives like glue to keep the wood pieces joined. Examples are **Dado, Tongue and groove, Mortise and Tenon and Dovetail joints**.

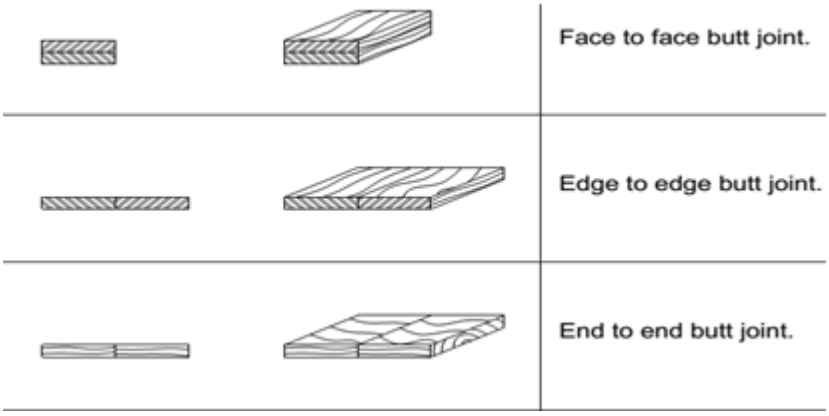
When you choose a wood joint you have to consider the following main points:

- ❖ *The strength of the joint*
- ❖ *The appearance of the joint*
- ❖ *How difficult they are to make/how you make that particular joint?*
- ❖ *The kind of wood*
- ❖ *The direction of the grain*

Mechanical Wood Joints

1. Butt joint

- It is a joint made by two squared pieces of woods.
- The two pieces come together but they do not overlap & one piece is not set into the other.
- we use a fastener of some kind to keep the joint together & to make it stronger.
- Butt joint is used in making simple box & in building up stock.
- It is the simplest of all types of joint.
- Butt joint can be made in 5 different ways: Edge to edge, Face to face, End to edge, End to face and edge to face.



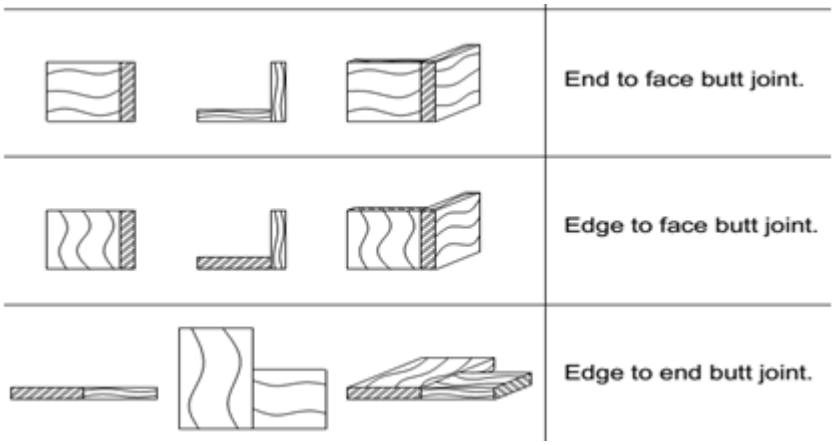


Fig. 88 Varieties of the butt joint

2. Miter joint

Miter joints are formed by cutting woods to a precise 45^0 to produce a rightangle when the joint is assembled. Mitre joint are used in picture frame, often in boxes, floors, ceilings, doors, etc. They may be strengthened with dowels, or metal fasteners.

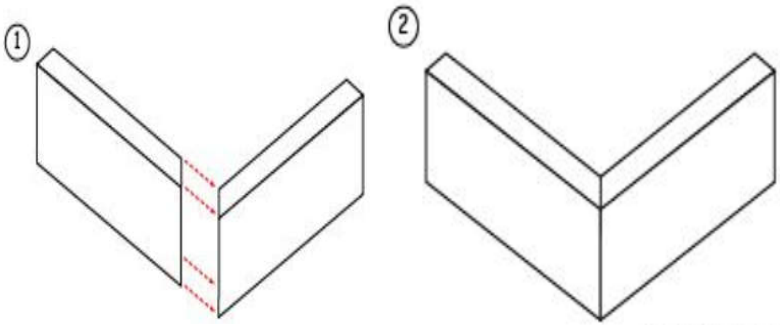


Fig 89 Miter for corner joint

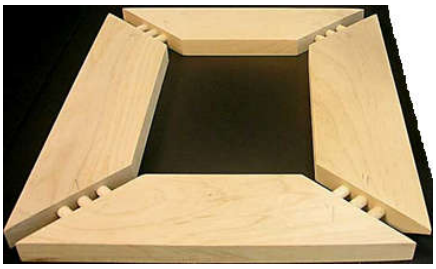


Fig 90 Miter joint with dowel fastener

3. Rabbet joint

A rabbet is an L-shaped recess cut at the end or along the edge of the stock. A squared end of another piece of stock can be fastened in to the recess to making the joint. An example of the use of a rabbet is in the back edge of a cabinet. The width of the rabbet must be equal to the thickness of the stock & the depth is usually1/2 to 2/3 of the thickness of the stock.

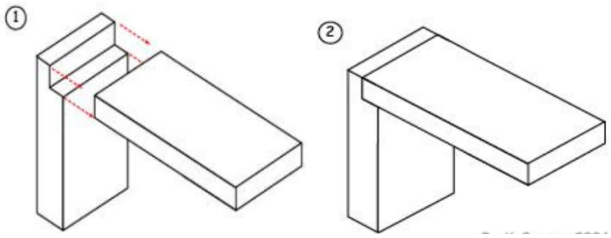


Fig 91 Rabbet joint

4. Lap joint

Is a joint made by cutting an equal amount from each piece (exactly *half the depth)* and joined each other by using glue, screws, nails & any other fasteners. When we assemble the pieces their surfaces are flush.

Kinds of lap joints:

i. Half lap joint:- used to join two piece of wood to increase length.

Fig 92 Half lap

ii. End lap joint:-these are used in screen doors, chair seats, of any work in corners in which the surface of piece must be flush.

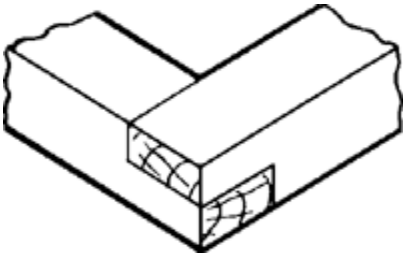


Fig 93 End lap

iii. Middle lap joint: - these are used for screen doors, cabinets, to make frames in house construction.

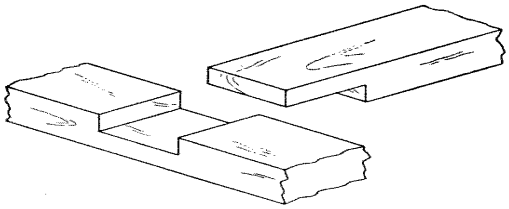


Fig 94 Middle lap

iv. Cross lap joint:-They are used when two pieces must cross each other & most of the time is flush on the surface like in furniture making.

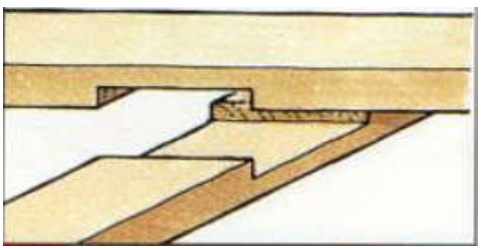


Fig 95 Cross lap

Self-check - 3	Written test

Direction: Match the definitions under column **"A"** with the terms under column **"B"**

"A"	***"B"***
1. A joint made by simply bringing two squared pieces of woods Together. **2.** A joint made by cutting an equal amount from each piece and joined each other to increase length. **3.** A joint made by cutting an L-shaped recess at the end or along the edge of the stock. **4.** A joint used like in photo frames. **5.** A fastener used for strengthening joints.	**A.** Dowel **B.** Half lap joint **C.** Butt joint **D.** Rabbet joint ***E.*** Miter joint

Note: **Satisfactory rating is 3 points and**
Unsatisfactory is below 3 points

Answer Sheet

Name _____ **Date** _____

Operation Sheet 3	Construct Mechanical Wood Joints

OPERATION TITLE: To Construct Butt Joint

PURPOSE: To Construct Butt Joint for widening (increasing the width) the given pieces of woods.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: all personal protective equipment, Jack plane, Pencil, clamps, Masking tape, Wood glue and brush, Rubber mallet.

Procedure:

Part 1: Preparation

1. Fix in vice and plane the first edge of the first piece with a jack plane to create a flat surface for the joint. Repeat this step for the second piece of wood.
2. Lay the joining edges of the two pieces on top of each other to check for uneven or excess parts which need to be planned. Use a pencil to mark.
3. Plane the marked area little at a time. Be sure to check the edges again and again. Continue planing until the edges fit together closely with no gaps.

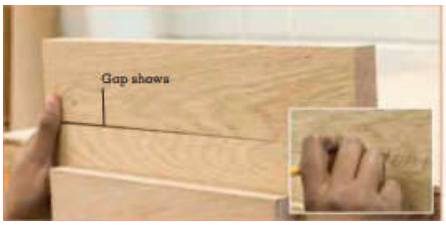


Fig 96 Mark uneven parts


Fig 97 Plane the marked area

ASSEMBLING THE JOINT

1. Set up the clamps, insert the two pieces of wood and adjust before gluing the joint.
2. Protect the wood by sticking masking tape or a piece of plywood to the bars.
3. Apply wood glue, spreading it evenly along the full length to one of the edges with a brush.
4. Clamp the two pieces together. Gently tap (beat) along the joint with a rubber mallet to ensure that the edges are flush with each other.
5. Tighten the clamps, to check that the two pieces remain perfectly aligned with each other.
6. Wipe away (clean) any excess glue and leave to dry for several hours ideally overnight.

Fig 98 Apply glue to one of the edges

Fig 99 Gently tap with a mallet

Fig 100 Clean the excess glue while it is wet

PRECAUTIONS:

- Observe safety in the work place.
- Use the right tool for the right work.
- Use appropriate OHS materials

QUALITY CRITERIA:

- ❖ Smooth surface and strong joint

Operation Sheet 4	Construct Mechanical Wood Joints

OPERATION TITLE: To Construct Rabbet Joint

PURPOSE: To Construct a rabbet joint with 90^0 junction.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and use sharp tools.

Equipment tools and materials: Pencil, Square, Marking gauge, Marking knife, Back saw, C-clamp, Bevel-edged, chisel Wood glue and brush, plane.

Procedure:

Marking out and cutting the joint:

1. Mark the position of the joint on the first piece using the thickness of the other piece, aligned approximately 1/16in (2 mm) from the end grain, as a guide.

2.Extend the mark around three sides with a square. With the marking gauge set to half the width of the wood, scribe around the two marked sides and the end.

3.Score (make) the lines with a marking knife, and then cut the waste with a tenon saw. Make sure you cut to the waste side of the scored line. Clean up the joint with a bevel-edged chisel, then follow Steps 1–3 to cut a joint in the second piece of wood.

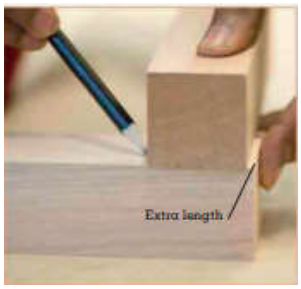


Fig 101Mark on the 1st piece

Fig 102 extend the mark a with a square

Fig 103 Score the line with marking knife

FINISHING THE JOINT

- Test-fit to ensure the faces are flush and form a 90^0 angle.
- Once a good fit has been achieved, apply glue to the joint and clamp with a C-clamp. Re-check the angle, wipe off excess glue, and leave it to dry. Once the glue has dried, use a bench plane or block plane to remove the excess length from the ends of the joint to achieve a flush finish on both edges.

Fig 104 Apply glue and fix it with clamp

Fig 105 The finished joint

PRECAUTIONS:

- Observe safety in work place.
- *Use the right tool for the right work.*
- *Use appropriate OHS materials*

QUALITY CRITERIA:

- Smooth surface and strong joint

Operation Sheet 5	Construct Mechanical Wood Joints

OPERATION TITLE: **Construct Cross Lap Joint**

PURPOSE: To construct a cross lap joint with two pieces of woods crossing each other at their middle.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: all personal protective equipment, measuring tape, Try square, Chisel, Jack plane, Pencil, clamps, Wood glue and brush, Rubber mallet.

Procedure:

STEP 1 Measure and mark for Cross-laps:

The first step in cutting cross lap joints is to lay out their location.

Fig 106 Mark the cross lap position

STEP 3: Cut fillets:

You can use hand or power saws.

Fig108 Cut the cross lap space

STEP 2: Cut cross lap perimeters

The most important cuts in this process are the outermost ones–the "perimeters." These cuts will create the boundaries of the cross lap, so you want them to be tight and accurate.

Fig 107 Cut the cross lap perimeters

STEP 4: Break fillets:

Fig 109 Remove the cut scraps

STEP 5: Clean cross lap

The floor of the cut will still be very ragged, with some fillet bases standing higher than others.

Fig 110 Clean the groove with a chisel

STEP 6: Check for fit

Fig 111 Fit for check up

STEP 7: Repeat steps for overlapping section

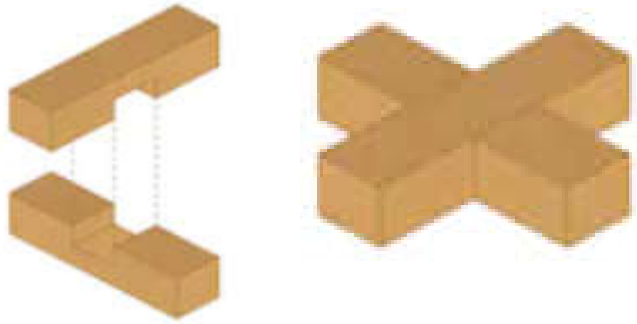


Fig 112 Final product

PRECAUTIONS:

- Observe safety in work place.
- *Use sharp tools*

QUALITY CRITERIA:

- Smooth surface and strong joint

Information Sheet-6	2B. Construct Non-Mechanical Wood Joints

1. Dado joint

Dado joint is a groove which is cut across the grain of a piece of wood. We fit a second piece of wood into the dado to make the joint. It is similar to a rabbet joint, except that it is not located along the edge or end of the stock.We use dado joint in drawers, shelves, step ladders, & many other wood work jobs.

There are three types of dado joints

i. Through dado joint

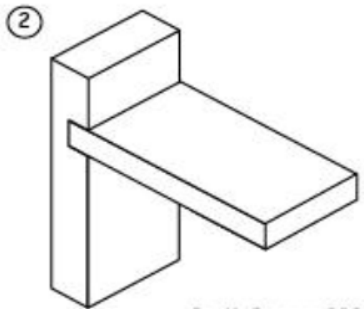


Fig 113

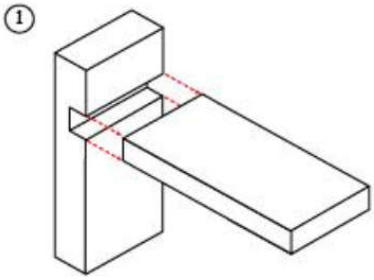


Fig 114 exploded view

ii. Blind dado joint

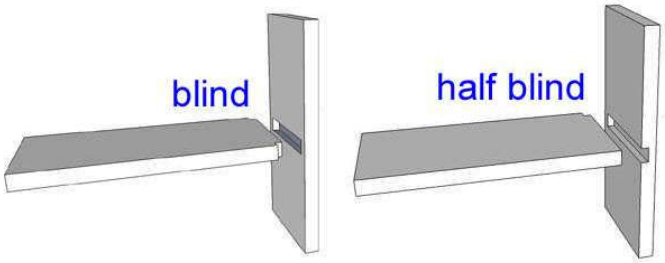


Fig 115 Blind dado joint

iii. Rabbet dado joint

Fig 116 Parts of the dado joint

2. Tongue and Groove Joint

Tongue and groove is made by cutting a slot (groove) along one edge. The other piece has a tongue cut on the mating edge. As a result, two or more pieces fit together closely. You can use it to make wide tabletops out of solid wood. Some other uses are in wood flooring, parquetry, paneling, etc.

Fig 117 The tang and the groove

3. Dovetail joint

Dovetail joints consists of wedge- shaped projections that fit into a matching recess. It is a strong woodworking joint, and is great for tensile strength **(***resistance from pulling apart***)**. It is widely used for high quality furniture and cabinets. It can be cut carefully by hand. However, the most efficient means of making a dovetail joint is by using a router and dovetail fixtures.

A series of pins cut to extend from the end of one board interlock with a series of tails cut into the end of another board. The pins and tails have a trapezoidal shape. Once glued, the joint is permanent, and requires no mechanical fasteners. The dovetail joint is primarily used for drawer construction and other corner joints.

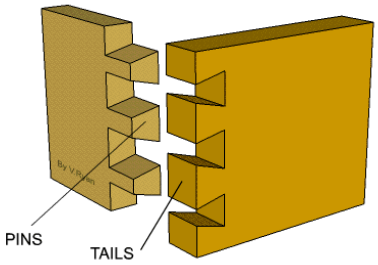


Fig 118 Pins and tails of the dovetail joint

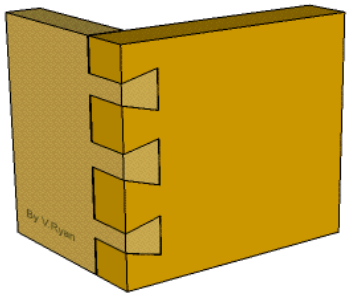


Fig 119 The finished dovetail joint

4. Mortise &tenon joint

It is one of the strongest woodworking joints. It joins two pieces of wood at 90^0.

- A mortise is a cavity cut into a piece of wood or rectangular recess to receive a tenon.
- A tenon is a rectangular projection on the end of a piece of wood to insert into a mortise.

You insert one end **(**tenon end**)** of a piece into a hole in the other piece. It is used to join the legs & rails to tables, benches & chairs, in making frames & a panel of the best quality.

The strongest mortise & tenon joint have the thickness of the tenon exactly 1/3 of the thickness of the timber.

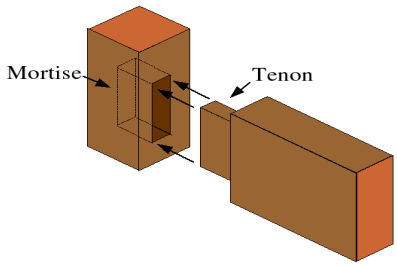


Fig 120 Mortise and tenon

Self-check - 4	Written test

Direction: Choose the best answer

1.A joint made between two squared pieces of woods is _____

A. Miter joint **B.** Butt joint **C.** Rabbet joint **D.** Lap joint

2.A joint made between two pieces of woods by cutting equal amount from each piece is ____

A. Butt joint **B.** Dovetail joint **C**. Mitre joint **D.** Lap joint

3.One of the following types of joint is weaker than the others. Identify it _____

A. Mortise and Tenon **B.** Dovetail **C.** Rabbet **D.** Finger

4.The best type of joint for constructing tables and chairs is _____

A. Mortise and Tenon **B.** Dovetail **C.** Rabbet **D.** Finger

5._____ joint is primarily used for drawer construction and other corner joints.

A. Mortise and Tenon **B.** Dovetail **C.** Rabbet **D.** Finger

Note: **Satisfactory rating is 3 points and**

Unsatisfactory is below 3 points

Answer Sheet

Name _____ **Date** _____

Operation Sheet-6	Construct Non-Mechanical Wood Joints

OPERATION TITLE: Construct Dovetail joint

PURPOSE: To construct a dovetail joint

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: all personal protective equipment, pencil, measuring tape, Try square, marking gauge, Back saw, Chisel, Jack plane, Pencil, clamps, Wood glue and brush, Rubber mallet.

Procedure:

I. Marking out the tail

1. Set the socket piece on top of the tail piece, with the end grain of the tail piece protruding (extending beyond) by up to 1/16in (2 mm). Mark a line at either side of the socket piece, and extend the lines onto all four sides of the tail piece with a square.
2. Mark the position of the lap on the socket piece, using the tail piece as a guide. Square the measurements around, all four sides.

Fig 121 Mark the socket on the tail

3. Decide on the depth of the lap and scribe this measurement around the edges and end grain of the tail piece. Scribe with a marking knife the shoulder lines on both edges and on the underside (the waste side) of the tail piece.
4. Using a square edge as a guide, mark the tail from the end grain to the shoulders on the face side of the tail piece.

Fig 122 Mark the tail using a square

II. Cutting the tail

1. Secure the tail piece in a vise at an angle and cut the waste from the back of the tail using a Back-saw. Saw diagonally through the end grain to the shoulder.
2. Turn the piece in the vice and saw diagonally from the other direction. Finally, saw vertically to the shoulder.

Fig 123 Cutting the tail

3. Using a bevel-edged chisel, cut a V-groove along the shoulder line at the back of the tail.
4. Remove the waste by cross-cutting along the shoulder line with a Back-saw.
5. Clean up the shoulder and edges with a chisel.
6. Scribe across the end grain from the marks made in Step 4 of Marking out the tail with a marking knife and square.
7. Set the tail piece in the vice so that the line marking one side of the tail is vertical. Cut down the end grain to the shoulder with a back saw. Repeat to cut the other side of the tail

Fig 124 Marking and cutting the side of the tail

8. With the tail piece secured in vice, chisel a V-groove along the shoulder line on edges of the tail.
9. Remove the waste by sawing down the shoulder line on each edge and the back face. Clean up the shoulders with a chisel.

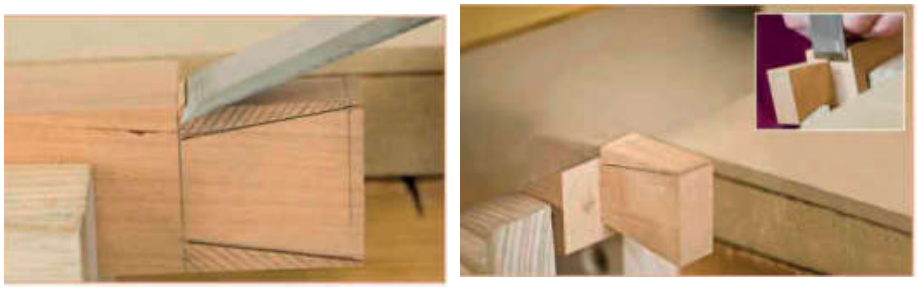


Fig 125 Remove the waste part using a chisel

III. Marking out the socket

1. Set the tail in position over the socket piece, aligned at the shoulder. Scribe around the tail with a marking knife. Square the marks onto the edges.
2. Mark the depth of the socket on both edges using the marking gauges as previously set. Use a back saw to cut the edges of the socket to this depth.
3. Make relief cuts through the waste. Chop horizontally with a chisel to remove the waste. Clean up the base and the edges with a chisel.

Fig 126 Make relief cuts and chisel it to clean the joint

4. Test the fit of the joint and adjust as necessary. Saw of the excess length of the tail and plane flush to the edge of the socket piece using a plane.

Fig 127 Tesst (check) if it fits

Fig 128 The final joint

PRECAUTIONS:

- Observe safety in work place.
- *Use sharp tools*

QUALITY CRITERIA:

- Smooth surface and strong joint

Operation Sheet-7	Construct Non-Mechanical Wood Joints

OPERATION TITLE: Construct Dado joint

PURPOSE: To construct a Dado joint

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: all personal protective equipment, Marking knife, Square, Ruler, Appropriately sized chisel (slightly smaller than the thickness of the housing), Marking gauge, Pencil, Back-saw, Wooden mallet, Rubber mallet, Wood glue and brush, Clamps

Procedure:

I. Marking out the housing

1. Score (make) a single line on the face of the housing piece with a marking knife and square to mark the position of the housing.
2. Measure the width of the end grain of the tenon piece (A) to determine how wide you will need to cut the housing.
3. Mark the width of the tenon (A) on the housing piece. This defines the width of the housing.

Fig 129 Mark a single line

Fig 130 Measure the thickness of the tenon piece

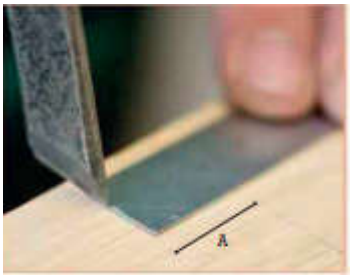


Fig 131 Mark the thickness of the tenon on the dado surface

4. Square this line across the face of the housing piece. Using the marking knife and square.
5. The thickness of the housing piece determines the housing depth. Set the marking gauge to between one third and one half of this measurement (B).
6. Extend the width marks around the edge of the housing piece on both edges, using a pencil and square.
7. Use the ***making gauge*** to scribe the depth of the housing between the width marks on both edges.
8. Score along the width marks that you have made in pencil, using the marking knife and square.

Fig 132 Determine the depth of the dado and mark it

II. Cutting the housing

1. Use a chisel a V-grove along each of the housing lines on the face of the housing piece. Cut along the grooves with a back-saw to the depth indicated by the edge markings. Loosen the waste with a chisel by making vertical cuts along the width of the housing.
2. Use a chisel and wooden mallet to remove the bulk of the waste from the housing by chopping horizontally. Trim the base and edges with the chisel, smoothing of any loose cuts, splinters and rough edges.

Fig 133 Cut the dado with a chisel

III. Assembling the joint

1. Insert the tenon piece into the housing. Use a rubber mallet to lodge (fix) the tenon in place.
2. Check that the fit is square by holding a square against the joint, then glue and clamp.

Fig 134 Insert the tenon in the dado Using mallet

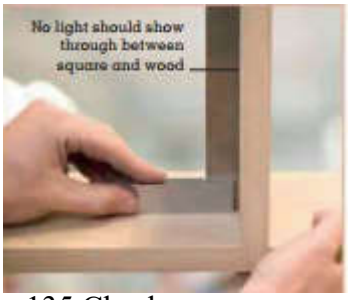


Fig 135 Check squareness

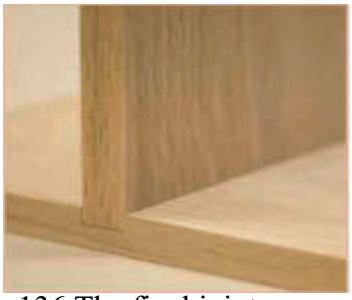


Fig 136 The final joint

PRECAUTIONS:

- Observe safety in work place
- *Use sharp tools*

QUALITY CRITERIA: Smooth surface and strong joint

LAP Test **Practical Demonstration**

Name:_____ Date: _____

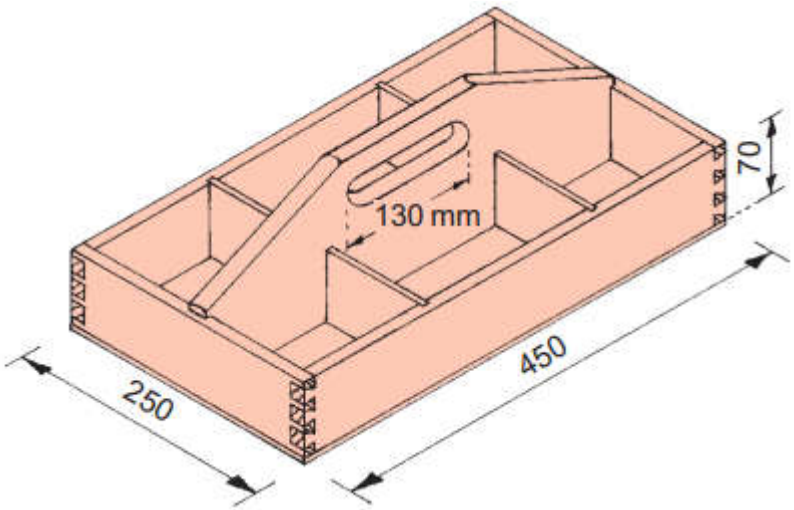
Time Started: _____Time Finished: _____

Instructions: You are required to perform the following activities:

a. Construct the nail box shown in the following pictorial drawing.

- You have to interpret the drawing properly
- Use 2-2.5cm thick timber
- Use dovetail joint for corners.
- Use dado and but joints for the other parts as required.
- All dimensions are given in mm.

Time allowed is 6:00



Learning Guide # 3

Unit of Competence:

Unit Title: Install and Replace Windows and Doors

Unit Code: EIS CRP2 08 1118

&

Unit Title: Maintain Non-structural and Structural Carpentry Components

Unit Code: EIS CRP2 09 1118

Information Sheet-7	3 Anatomy of the house

Structural and non-structural components of a building:

Structural component: is any internal or external load-bearing component of the building that is essential to the stability of the building or any part of it, including (but not limited to), foundations, floors, walls, roofs, columns and beams.

Non-structural Components: are not load bearing members of the building. Examples- mechanical and electrical plant, pipe work, cable trays, suspended ceilings, doors, windows, etc.

Anatomy of a House

Many remodel projects, like adding new doors or windows, require that you remove one or more studs in a load-bearing wall to create an opening. When planning your project, remember that new openings require a permanent support beam called a header, above the removed studs, to carry the structural load directly.

The required size for the header is set by local building codes and varies according to the width of the rough opening. For a window or door opening, a header can be built from two pieces of 2-inch dimensional lumber sandwiched around 3⁄8-inch plywood. When a large portion of a load-bearing wall (or an entire wall) is removed, a laminated beam product can be used to make the new header.

If you will be removing more than one wall stud, make temporary supports to carry the structural load until the header is installed.

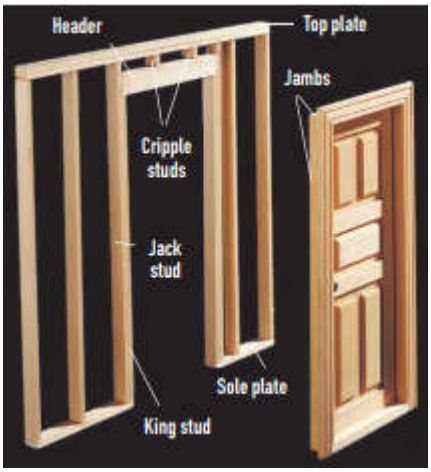


Fig 137 Door opening

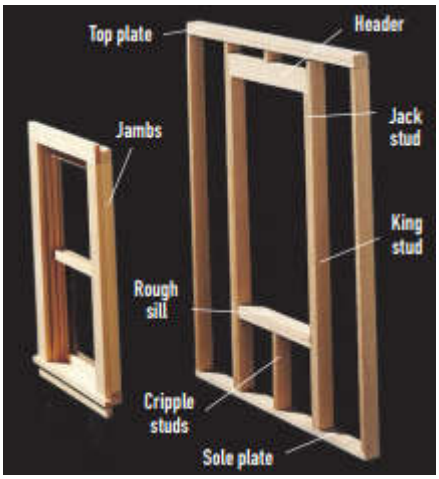


Fig 138 Window opening

Door opening: The structural load above the door is carried by cripple studs that rest on a header. The ends of the header are supported by ***jack studs*** (also known as trimmer studs) and ***king studs*** that transfer the load to the sole plate and the foundation of the house. The rough opening for a door should

be 1" wider and 1⁄2" taller than the dimensions of the door unit, including the jambs. This extra space lets you adjust the door unit during installation.

Window opening: The structural load above the window is carried by cripple studs resting on a header. The ends of the header are supported by ***jack studs*** and ***king studs***, which transfer the load to the sole plate and the foundation of the house. The rough sill, which helps anchor the window unit but carries no structural weight, is supported by cripple studs. To provide room for adjustments during installation, the rough opening for a window should be 1" wider and 1⁄2" taller than the window unit, including the jambs.

Before you start a carpentry project, you should familiarize yourself with a few basic elements of home construction and remodeling (Modifying). Take some time to get comfortable with the terminology of the models shown on the next few pages. The understanding you will gain in this section will make it easier to plan your project, buy the right materials, and clear up any confusion you might have about the internal design of a home project.

If your project includes modifying exterior or load-bearing walls, you must determine if your house was built using ***platform*** or ***balloon-style framing***. The framing style of your home determines what kind of temporary supports you will need to install while the work is in progress. If you have trouble determining what type of framing was used in your home, refer to ***the original blueprints***, if you have them, or ***consult a building contractor*** or ***licensed home inspector***.

Framing in a new door or window on an exterior wall normally requires installing a header. Make sure that the header you install meets the requirements of your local building code, and always install cripple studs where necessary.

Floors and ceilings consist of sheet materials, joists, and support beams. All floors used as living areas must have joists with at least 2 × 8 in construction. There are two types of walls: ***load-bearing*** and ***partition***.

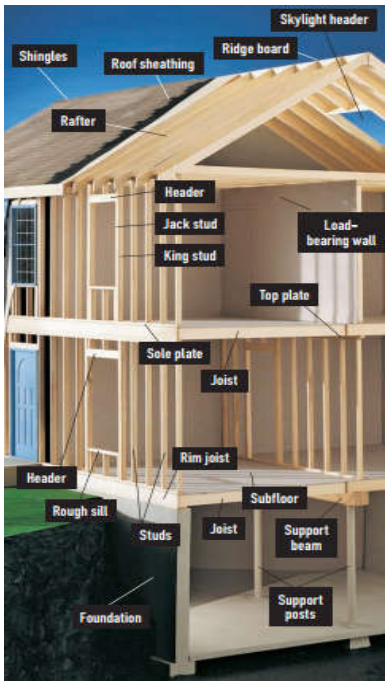


Fig 140 A house with platform framing

Fig 139 Platform framing

***Platform framing*:** is identified by the floor-level sole plates and ceiling-level top plates to which the wall studs are attached.

Fig 141 Balloon framing

Balloon framing: is identified by wall studs that run uninterrupted from the roof to a sill plate on the foundation, without the sole plates and top plates found in platform-framed walls.

Fig 142 A house with balloon framing

Wall Anatomy

• ***Load-bearing walls*** carry the structural weight of your home. In platform-framed houses, load-bearing walls can be identified by double top plates made from two layers of framing lumber. Load-bearing walls include all exterior walls and any interior walls that are aligned above support beams. ***Load-bearing walls*** require temporary supports during wall removal or framing of a door or window.

Fig 143 Load bearing wall

Partition walls are interior walls that do not carry the structural weight do not require temporary supports. They have a single top plate and can be perpendicular to the floor and ceiling joists but are not aligned above support beams. Any interior wall that is parallel to floor and ceiling joists is a partition wall.

Fig 144 Partition wall

Floor & ceiling Anatomy

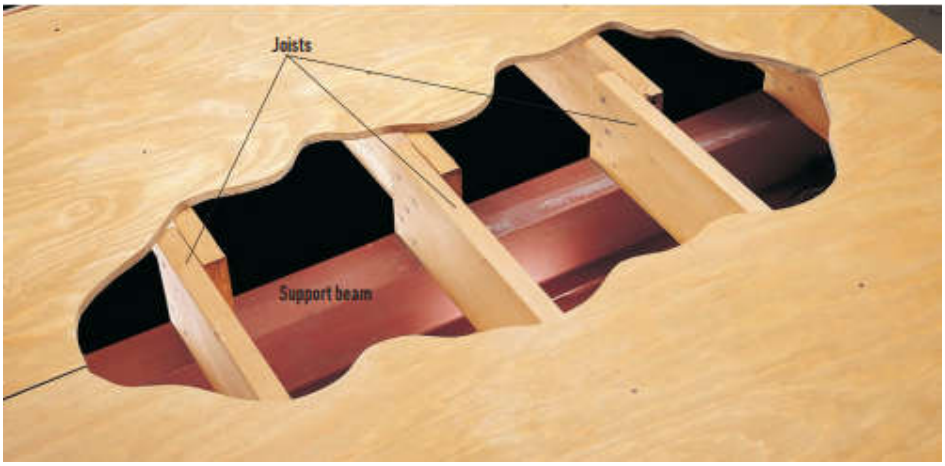
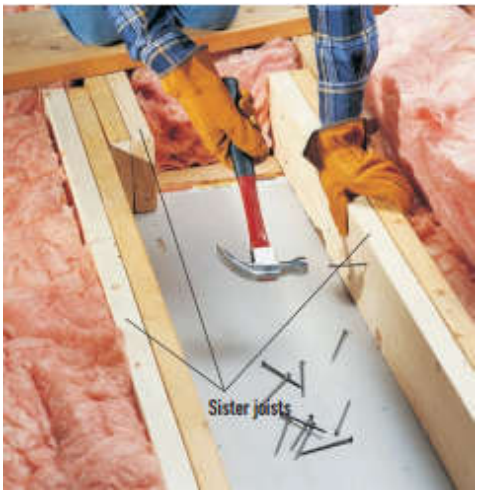


Fig 145 Floor shown cut away for clarity

Joists carry the structural load of floors and ceilings. The ends of the joists rest on support beams, foundations, or load-bearing walls. Rooms used as living areas must be supported by floor joists that are at least 2 × 8 in size. Floors with smaller joists can be reinforced with sister joists.



Floors with 2 × 6 joists, like those sometimes found in attics, cannot support living areas unless a sister joist is attached alongside each original joist to strengthen it. This often is necessary when an attic is converted to a living area.

Fig 146 Floors with 2 × 6 joists

Sister joists also are used to help support a header when ceiling joists must be cut, such as when framing a skylight shaft

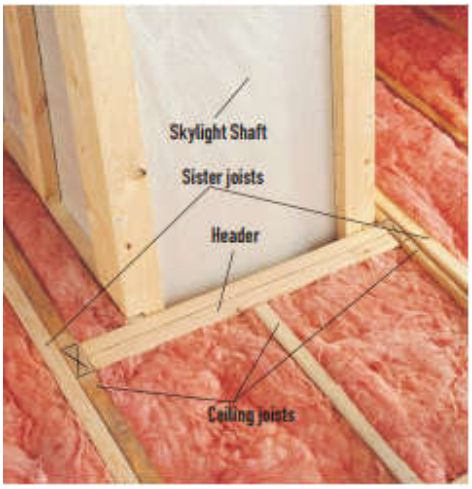


Fig 147 sister joist

Partition walls :

Fig 148 A typical partition wall

A typical partition wall consists of top and bottom plates and 2 × 4 studs spaced 16" on-center. Use 2 × 6 lumber for walls that will hold large plumbing pipes.

Partition walls are non-load-bearing walls typically built with 2 × 4 lumber, but they can also be built with 35⁄8-inch steel studs. Walls holding plumbing pipes can be framed with 2 × 6 lumber. On a concrete floor, use pressure-treated lumber for the bottom plates.

This project involves building a wall in place, rather than framing a complete wall on the floor and tilting it upright, as in new construction. The build-in-place method allows for variations in floor and ceiling levels and is generally much easier for remodeling projects.

Check the local building codes for requirements about fire blocking in partition walls. And after your walls are framed and the mechanical rough-ins are completed, install metal protector plates where pipes and wires run through framing members.

Nail guns will help improve your nailing accuracy. You'll never need to worry about a glanced hammer blow denting the wood or bending a nail. Air nailers never miss the nail head. As long as you choose the

correct nails for the application and set the air compressor pressure properly, a pneumatic nailer will drive and set nails reliably, time after time.

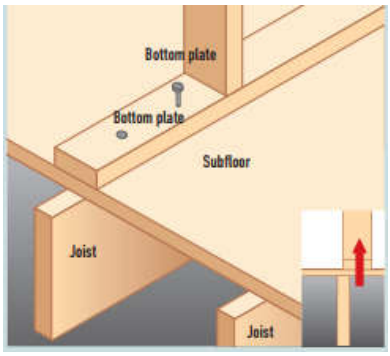
Variations for fastening top plates to joists

When a new wall is perpendicular to the ceiling or floor joists above, attach the top plate directly to the joists, using 16d nails.

Fig 149 A new wall is perpendicular to the ceiling

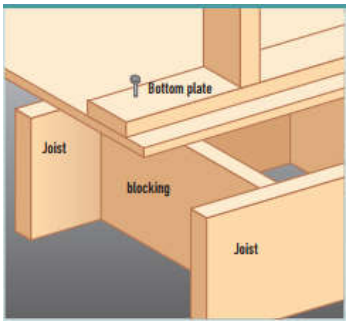
When a new wall falls between parallel joists, install 2 × 4 blocking between the joists every 24". If the new wall is aligned with a parallel joist, install blocks on both sides of the wall, and attach the top plate to the joist (inset).

Fig 150 A new wall falls between parallel joists



If a new wall is aligned with a joist below, install the bottom plate directly over the joist or off-center over the joist (inset). Off-center placement allows you to nail into the joist but provides room underneath the plate for pipes or wiring to go up into the wall.

Fig 151 a new wall is aligned with a joist below



If a new wall falls between parallel joists, install 2 × 6 or larger blocking between the two joists below, spaced 24" on center. Nail the bottom plate through the subfloor and into the blocking.

Fig 152 A new wall falls between parallel joists

TRIM MOLDINGS

Trim moldings give character (quality) and definition to many carpentry projects. In addition, you can sometimes use them to cover up carpentry mistakes, such as hiding small gaps in wall corners when the drywall hasn't been cut perfectly.

It's important to measure and cut moldings precisely so that when installed, they fit together snugly (tightly) without gaps. Pre-drilling moldings is recommended, especially when hardwoods such as oak (like 'koso' from indigenous trees) are used. Pre-drilling makes hand nailing easier, reduces splitting during installation, and makes it easier to set nails cleanly. There's no need to pre-drill when using a pneumatic nail gun. Most moldings should be painted or stained before installation. Cove moldings and wainscoting can be purchased with a factory coat of white paint. For stained surfaces, use a hardwood with a pleasing grain, such as 'koso'.

Trim moldings are both functional and decorative. They can be used to conceal gaps at the base and around the sides of a carpentry project, to hide the edges of plywood surfaces, or simply to add visual interest to the project. Moldings are available in dozens of styles. Synthetic trim moldings, available in many styles, are less expensive than hardwood moldings.

Fig. 153 Decorative moldings give a finished appearance walls, doors, windows, and cabinets.

Fig 154 Some commonly used Moldings

Door Frames for Prehung door

A **prehung door** comes already mounted into a frame and is installed all at once. **Door frames for prehung** doors start with king studs that attach to the top and bottom plates. Inside the king studs, jack studs support the header at the top of the opening. Cripple studs continue the wall-stud layout above the opening. The dimensions of the framed opening are referred to as the rough opening

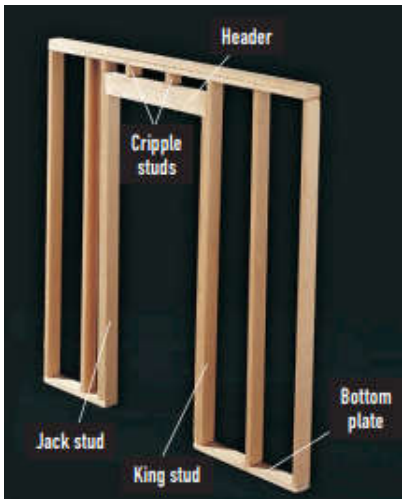
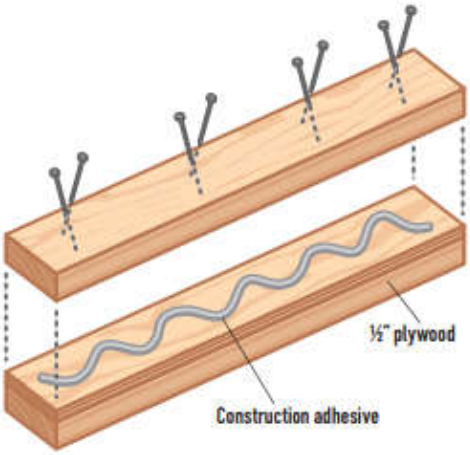


Fig 155 Door frame for pre-hung door



In non-load-bearing walls, the header may be a 2 × 4 laid flat. A built-up header is constructed of two 2× pieces of lumber glued and screwed around a piece of 1⁄2" plywood.

Fig 156 Header for non-load bearing wall

Framing widows:

Many Windows must be custom-ordered several weeks in advance. To save time, you can complete the interior framing before the window unit arrives, but be sure you have the exact dimensions of the window unit before building the frame.

Follow the manufacturer's specifications for the rough opening size when framing for a window. The listed opening usually is 1-inch wider and 1⁄2-inch taller than the actual dimensions of the window unit. The following pages show techniques for wood frame houses with platform framing.

Fig 157 Widow frame

Door and Widow casings

Door and Window Casings provide an attractive border around doors and windows. They also cover the gaps between door or window jambs and the surfaces of surrounding walls. Install door and window

casings with a consistent reveal between the inside edges of the jambs and casings, making sure the casings are level and plumb. In order to fit casings properly, the jambs and wall covering must lie in the same plane. If either protrudes, the casings will not lie flush. To solve this problem, you'll need to remove some material from whichever surface is protruding.

Tools & Materials

Tape measure, Pencil, Combination square, Nail set, Level, Straightedge, Power miter saw or miter box and backsaw, Hammer, Casing materials, 4d and 6d finish nails, Wood putty.

Options for installing Door & Window Casings

Add corner blocks, also known as rosettes, at the ends of the head casing. Attach the corner blocks once the side casings are in place, then cut the head casing to fit. Set he nails, using a nail set, after all pieces are installed

Fig 158 Corner blocks

Backband molding can dress up butted window casings. Install the back band around the perimeter of the window, mitering the joints at the corners. Nail the back band in place with 4d finish nails or pneumatic brads.

Fig 159 Backband molding

Base Molding

Baseboard trim is installed to conceal the joint between the finished floor and the wall covering. It also serves to protect the drywall at the floor. Installing plain, one-piece baseboard such as ranch style base or cove base is a straightforward project.

Outside corner joints are mitered, inside corners are coped, and long runs are joined with scarf cuts. The biggest difficulty to installing base is dealing with out-of-plumb and non-square corners. However, a T-bevel makes these obstacles easy to overcome. Plan the order of your installation prior to cutting any pieces and lay out a specific piece for each length of wall. It may be helpful to mark the type of cut on the back of each piece so you don't have any confusion during the install.

Locate all studs and mark them with painter's tape 6 inches higher than your molding height. If you need to make any scarf joints along a wall, make sure they fall on the center of a stud. Before you begin nailing trim in place, take the time to pre-finish the moldings. Doing so will minimize the cleanup afterward.

DOORS:

Doors can be categorized in a number of ways. They are:

- Flush or panel doors and
- Solid or hollow core.

They can be finished on the job with locks and butts or packaged, arriving on the job site complete with frame and hardware. They can likewise be divided according to their use such as front entrance doors and patio doors.

Two common classes of doors are the **flush door** and the **panel door**. **Flush doors** have flat surfaces on both sides. The finish consists of two or three plies of veneer or another type of covering, such as vinyl or hardboard.

Two types of flush doors are made:

- ***A solid core door*** is made up of small blocks glued together to form a core over which surface plies are then placed and glued.
- ***Hollow core doors*** are made of a honeycomb of an interlocking strip confined within a frame work of members, which are equivalent to the side stiles, top and bottom rails of other types of doors. Veneer sheets are glued to the framework to become the face plies.

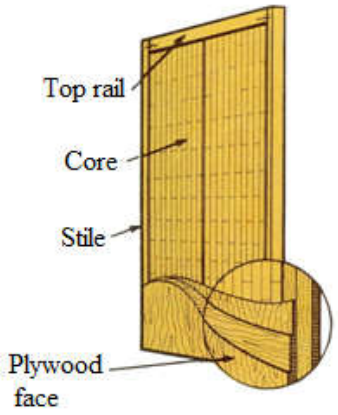


Fig 160 Solid core

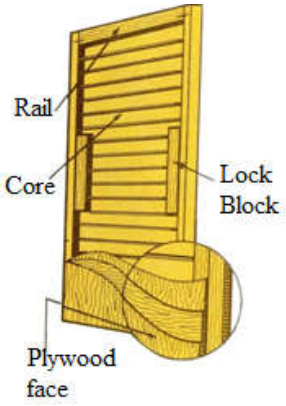


Fig 161 Hollow core

Panel doors are made with ***vertical members*** called ***stiles*** and ***horizontal members*** called ***rails***. A stile on one side of the door is rabbeted to receive the butts (hinges). The stile on the other side is mortised or drilled to receive the lock. The rails at the top, bottom and at the intermediate points serve to provide door strength and to hold it together. Additional vertical members are mullions and horizontal members are called rails which are used to divide the door

into any number of panels. Panels may be solid wood, plywood, and particleboard or have glass inserts. Panels, with or without raised surface, are held in place by the stiles and rails.

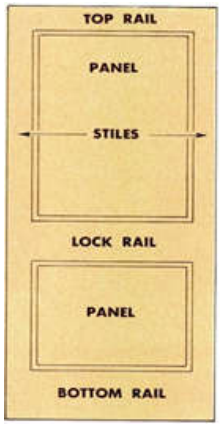


Fig162 Parts of a panel door

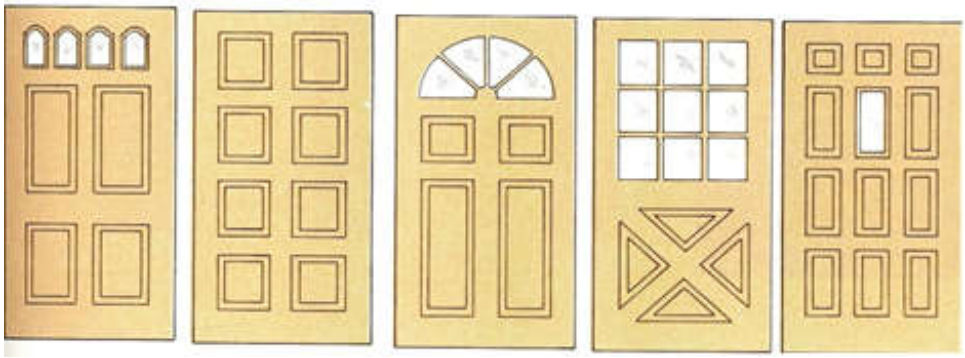


Fig 163 Wood panel doors and their different styles

Before the exterior covering is put on the outside walls, the door openings are prepared for the frames. Rough openings are usually made 2 1/2 inches larger each way than the size of the door to be hung. **(**For example, a 2-foot 8-inch by 6-foot 8-inch door would need a rough opening of 2 feet 10 1/2 space allows for the jambs, the wedging, and the clearance space for the door to swing.**)**

Door Frames

Door frames are made of the following parts:

The head casing, the jambs (head and two sides 'መቃን') and the sill (on exterior doors only). Interior door frames have no sill and no casing, otherwise they are the same as the exterior frames.

Doors and frames may be fabricated in the shop and installed separately; they may also be purchased ready for installation. The door jambs (linings of the framing of door opening) are rabbeted to depths of 1/2 inch. The rabbet prevents the door from swinging through the frames. A strip of wood may be used instead of a rabbet.

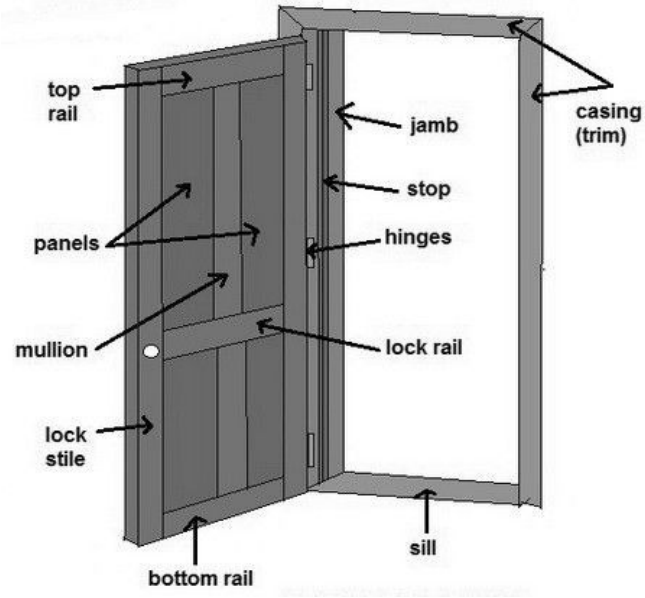


Fig 164 Door parts

Door hardware

The working mechanism of locks, fasteners, bolts, etc. should be kept free from paint, etc. and be lubricated to ensure trouble-free use. Items of hardware found to be defective through wear should be replaced with their nearest alternative.

Most doors are hung with the ***loose-pin butt hinge***, ***Lift-off butt hinge*** *or* ***loose butts*** and ***Cast butt hinge***. The hinges are manufactured with different designs. Doors should be hinged so that they open in the direction of the natural entry, open out in public buildings, and swing against a blank wall whenever possible and never into a hallway (entrance into a hall).

Fig 165 loose-pin *butt hinge*

Fig 166 Lift-off butt hinge

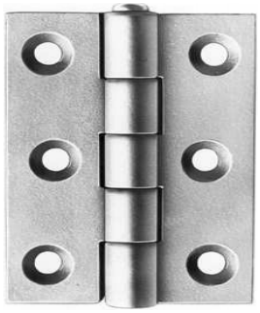


Fig 167 Cast butt hinge

Exterior doors use **three hinges** to reduce warping caused by the difference in exposure on opposite sides and to support wider and heavier exterior doors. Interior doors use **two hinges**.

When installing hinges, the cutout, a mortise is made to receive a leaf of the hinge. The depth is determined by the hinge's thickness, and the width is determined by the hinge's size.

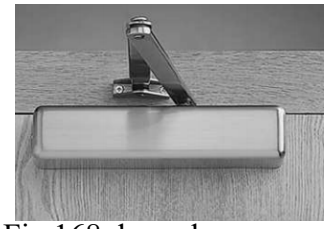


Fig 168 door closer

The **door closer** *is a* mechanical device which forces or encourage a door to close on its own. Install the door closer according to the manufacturer's instruction.

***Door locks*:**

Two types of locks used in construction are the *cylinder* and other light duty locks. *Cylinder locks* are sturdy (strong), and heavy-duty locks designed for installation in exterior doors. They provide high security.

Light-duty locks are used for interior doors on bathrooms, bedrooms, passages, and closets. Since door locks differ, use lock-set installation instructions. But the general principle of procedure for lock installation is given to you on operation sheet.

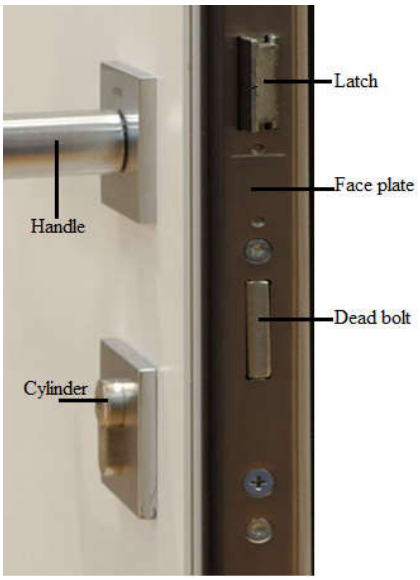


Fig 169 Door lock

The Cylinder is critical part of the door lock. It is the part which contains the "code" for the key and determines whether the door locks and unlocks. If a cylinder is sticking, has a key broken off in it, or is damaged, then you may need to replace the cylinder entirely. In this case you can purchase a new cylinder with its key and replace it.

WINDOWS

Some windows used in residences, hotels and other buildings are made from aluminum and steel. However, most of them are made from wood. Even if wood has an esthetic advantage on metals, wood will decay under certain conditions and must be treated with preservatives. Exposed surfaces must be kept painted.

Metal is stronger than wood and thus permits the uses of smaller frame members around the glass. Aluminum has the added advantage of a protective film of oxide, which eliminates the need of paint.

Types of window

In general windows can be classified into three types:

a. Sliding

b. Swinging

c. Fixed

Each of these includes a variety of designs or methods of operations:

- Sliding windows includes the double-hang and horizontal sliding.
- Swinging windows that are hinged on a vertical line are called casement windows
- While those hinged on a horizontal line can be either awning or hopper windows.

Descriptions of some important windows are given below:

1. Double-hung window

The double-hung window is made of upper and lower sashes that slide vertically past one another. These are held in any vertical position by a friction fit against the frame or by springs and various balancing devices. Double-hung windows are widely used because of their economy, simplicity of operation and adaptability to many architectural designs. With **single-hung windows**, only the bottom sash moves and the top half is permanently fixed.

2. Horizontal sliding window

It has two or more sash. At least one of them moves horizontally within the window frame. The most common design consists of two sashes, both of which are movable. When three sashes are used, the center one is usually fixed.

3. Casement Window

A casement window (*out-swinging or in-swinging)* has a sash that is hinged on the side and wings outward or in-ward. Installations usually consist of two or more units, separated by

mullions. Sashes are operated by a cranking mechanism or a push bar mounted on the frame, fig 8.3. Latches are used to close and hold the sash tightly against the weather stripping. The swing sash of a casement window permits full opening of the window. This provides good ventilation.

Crank operators make it easy to open and close windows located above kitchen cabinets or other built in fixtures.

4. Awning window

It has one or more sash that is hinged at the top and swing out at the bottom, fig 8.4. They are often combined with fixed units to provide ventilation. Several operating sash can be stacked vertically in such a way that they close on themselves or on rails that separate the units. Most awning windows have the so-called projected action because of the sliding friction hinges at the top rail which moves down as the bottom of the sash swings out.

5. Hopper window

It has a sash that is hinged along the bottom and swings inward, fig 8.5. It is operated by a locking handle located in the top rail of the sash. Hopper windows are easy to wash and maintain. They often interfere with drapes, curtains and the use of inside space near the window.

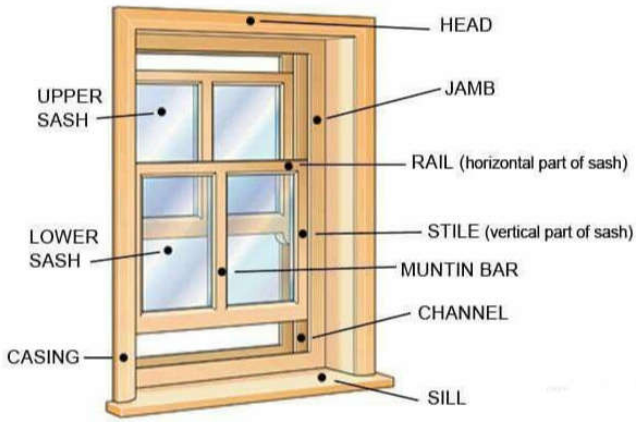


Fig 170 Double hang window

Fig 171 Horizontal sliding window

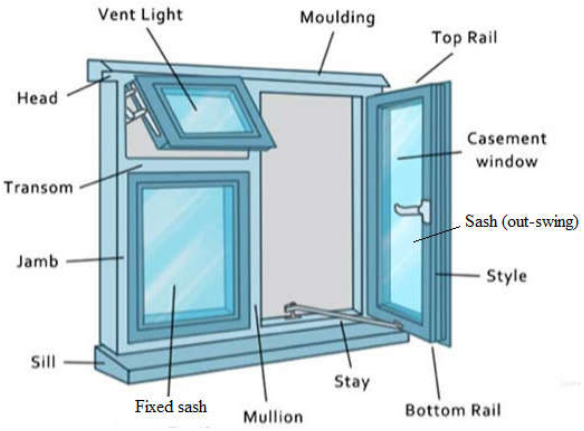


Fig 173 Awning window and fixed sash

Fig 172 Casement window with awning

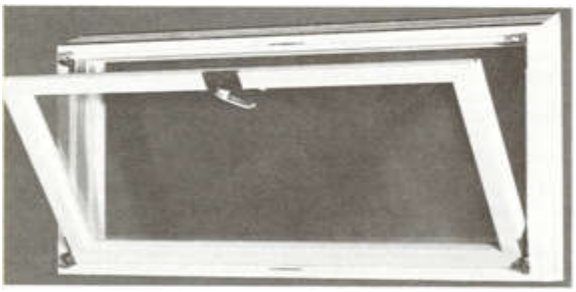


Fig 174 Hopper window

**The sash is the framework that holds the glass in the window.*

WINDOW FRAMES

All windows consist of two parts, the *frame* and the *sash.*

Window frames are made of four basic parts:

- the head,
- the jambs (two left and right), and
- the sill.

- **Sills** have a usual slope of 20 - 25% so that they shed water quickly. They are wider than frames, usually extending about 1 1/2 inches beyond the sheathing.

Installation of window

- If rough openings are plumb, level and the correct size, it is easy to install modern windows. Most window units and multiple unit combinations are installed from the outside.
- After the window is in place, use wedge blocks under the sill and raise the frame to the correct height as marked on the story pole.

- Adjust the wedges so the frame is perfectly level.
- Check, to see that, the unit is horizontally centered in the rough opening. Secure this position by driving several roofing nails (1 ½ inch long) through the lower flange and into the rough sill.
- Plumb the side jambs with a level and check the corners with a framing square. The sash should be closed and locked in place.
- Check for front-to-back plumb. Place the level on the outside face of the frame and make sure the window is not tilted outward or inward.
- Drive several nails temporarily into the top of the side casings. Finally, nail the window permanently in place with 1 ¾ inch or longer galvanized nails.

Installation of doors

Outside doorframes are installed in the same manner as the windows. Follow similar procedures. Secondary and service entrances usually have frames and trim members to much the windows. However, main entrances often contain additional elements that add an important decorative architectural feature. Exterior doors in residential construction are nearly always 2.10m high.

Outside doorframes, like window, have heads, jambs and sills. Door frames are manufactured at a mill work plan and arrive at the building site either in assembled or knocked down way. In residential construction, outside door swing inward and the rabbet must be located on the inside. Stock door frames are designed for standard wall framing. However, they can also be adapted to stone or brick veneer construction.

Stock frames can be fitted with extension strips that convert the frame to fit greater wall thicknesses. Extension strips are also used on window frames. Doorsill design varies considerably. However, the top is always level with the finished floor. Sills may be made of wood, metal, stone or concrete. Positioning a doorsill so it will be level with the finished floor require cutting away a section of the rough floor. Part of the top edge of the floor joist must also be cut away. This is done at the time the frame is installed.

Place the frame in the opening, center it horizontally and secure it with a temporary brace. Using blocking and wedges level the sill and bring it to the correct height. Be sure the sill is well supported. For masonry walls and slab floors, the sill is usually placed on a bed or mortar. With the sill level, drive a nail through the casing into the wall frame at the bottom of each side. Insert blocking or wedges between the studs and the top of the jamb. Adjust wedges until frame is plumb. Use a level and straightedge as shown in fig below.

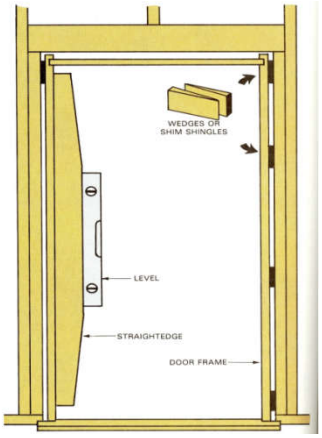


Fig 175 How to plumb the door jamb

Place additional wedges between the jambs and stud frame in the approximate location of the lock strike plate and hinges. Adjust the wedges until the side jambs are well supported and straight. Then, secure the wedges by driving a nail through the jamb, wedge and into the stud.

Finally nail the casing in place with nails spaced 16 inch C/C (centre to centre). Follow the same precautions suggested for window frame installation.

Door and Window repairs:

Door frames, and indeed window frames if not properly protected or maintained will lead to the frame being repaired or at worst removed and replaced.

Door frame repairs:

The figure at the right shows the sequence of removing sections of a frame if it needs replacing. Make 45° cuts sloping down towards the exterior – in this way, water is shed away from the joint.

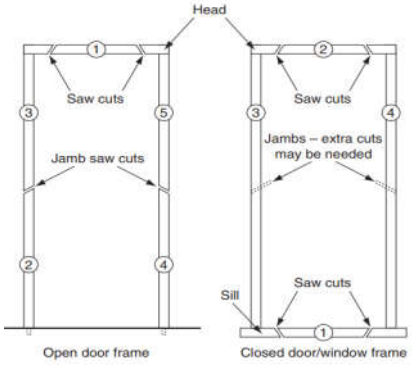


Fig 176 Numbered sequence for removal from opening

- Remove the defective portion. Expose and clean out the anchor peg (ኩሶ) hole.
- Use a sharp chisel to chop away waste when forming the scarf.

Window frame repairs

The sill and the bottom of jambs and mullions are the most likely places in which to find rot. Jambs and mullions can be dealt with in the same way as door jambs. Window sills can present problems,

especially if the defects extend from outside to beyond the front line of the sash. In this case it would be advisable to replace the whole window.

Note: *The removal of window frames is similar as for door frames. Three measurements of width and height should be taken across the opening, along with the squareness of the opening by taking diagonal measurements. The smallest measurement of height and width will determine the manufacturing size.*

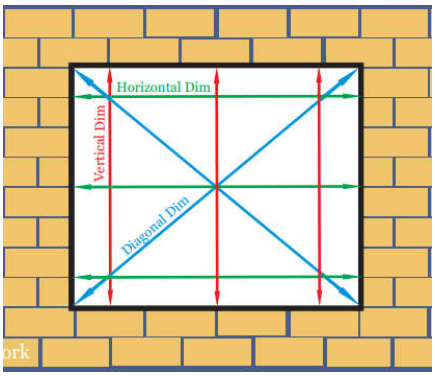


Fig 177 Measurements to be taken to determine the widow frame size

Re-glazing a window

An opening light should be unscrewed from its frame and broken glass removed safely. However, broken glass within a fixed light must be treated with extra caution – operatives should at all time position themselves at a safe distance above and away from the window, in case any broken pieces of glass are removed during the work.

Self Check	Written Test

Direction: answer the following questions

1. Differentiate between structural and non-structural components of a building. (2 points)
2. Mention any five types of door and window hardware. (5 points)
3. Explain the difference between double-hang and casement windows. (3 points)
4. Practice in your own way and state in simple steps how a mortise lock cylinder can be changed. (5 points)

Note: **Satisfactory rating is 7.5 points and**

Unsatisfactory is below 7.5 points

You can ask your teacher for the copy of the correct answers.

Answer Sheet

Name _____ **Date** _____

Operation Sheet-8	Partition wall

OPERATION TITLE: **Building Partition walls**

PURPOSE: To construct a partition wall

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: Protective eyewear, Chalk line, Circular saw, Framing square, Plumb bob, Powder-actuated nailer, T-bevel, 2 x 4 lumber, Blocking lumber, 16d and 8d common nails, Concrete fasteners, Drywall screws.

Procedure:

1. Mark the location of the leading edge of the new wall's top plate, then snap a chalk line through the marks across the joists or blocks. Use a framing square, or take measurements, to make sure the line is perpendicular to any intersecting walls. Cut the top and bottom plates to length.
2. Set the plates together with their ends flush. Measure from the end of one plate, and make marks for the location of each stud. The first stud should fall 15 1⁄4" from the end; every stud thereafter should fall 16" on center. Thus, the first 4 × 8-ft. drywall panel will cover the first stud and "break" in the center of the fourth stud. Use a square to extend the marks across both plates. Draw an X at each stud location.
3. Position the top plate against the joists, aligning its leading edge with the chalk line. Attach the plate with two 16d nails driven into each joist. Start at one end, and adjust the plate as you go to keep the leading edge flush with the chalk line.
4. To position the bottom plate, hang a plumb bob from the side edge of the top plate so the point nearly touches the floor. When it hangs motionless, mark the point's location on the floor. Make plumb markings at each end of the top plate, then snap a chalk line between the marks. Position the bottom plate along the chalk line, and use the plumb bob to align the stud markings between the two plates.

Fig 178 Step 1

Fig 179 Step 2

Fig 180 Step 3

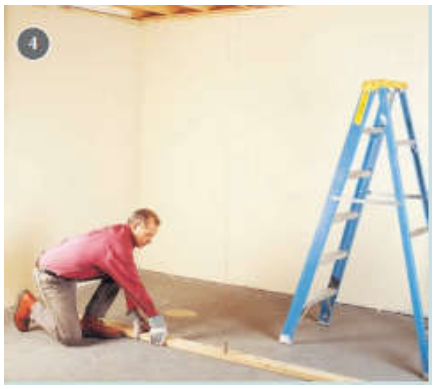


Fig 181 Step 4

5. Fasten the bottom plate to the floor. On concrete, use a powder-actuated nailer or masonry screws, driving a pin or screw every 16". On wood floors, use 16d nails driven into the joists below.
6. Measure between the plates for the length of each stud. Cut each stud so it fits snugly in place but is not so tight that it bows the joists above. If you cut a stud too short, see if it will fit somewhere else down the wall.
7. Install the studs by toe nailing them at a 60° angle through the sides of the studs and into the plates. At each end, drive two 8d nails through one side of the stud and one more through the center on the other side.

Fig 182 Step 5

Fig 183 Step 6

Fig 184 Step 7

Framing corners (shown in cut away)

A. **L-corners:** Nail 2 × 4 spacers (A) to the inside of the end stud. Nail an extra stud (B) to the spacers. The extra stud provides a surface to attach drywall at the inside corner.

B. T-corner meets stud: Fasten 2 × 2 backers (A) to each side of the side-wall stud (B). The backers provide a nailing surface for drywall.

C. T-corner between studs: Fasten a 1 × 6 backer (A) to the end stud (B) with drywall screws. The backer provides a nailing surface for drywall.

Fig 185 L-corners

Fig 186 T-corners meet studs

Fig 187 T-corner between studs

PRECAUTIONS:

- Observe safety in work place.
- Use sharp tools
- Perform measurements with great care

QUALITY CRITERIA:

- ❖ Wall constructed according to plan, good strength and appropriate materials.

Operation sheet-9	Door frame for Pre-hung door

OPERATION TITLE: Construct a door frame for a pre-hung door

PURPOSE: To make the door opening ready for the pre-hung door to come.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: Hammer, Framing square Tape measure, Hand saw, Timber, Protective eyewear, Plumb bob, 16d and 8d common nails.

Procedure:

1. To mark the layout for the door frame, measure the width of the door unit along the bottom. Add 1" to this dimension to determine the width of the rough opening (the distance between the jack studs). This gives you a 1⁄2" gap on each side for adjusting the door frame during installation. Mark the top and bottom plates for the jack and king studs.
2. After you've installed the wall plates, cut the king studs and toenail them in place at the appropriate markings.
3. Measure the full length of the door unit, then add 1⁄2" to determine the height of the rough opening. Using that dimension, measure up from the floor and mark the king studs. Cut a 2 × 4 header to fit between the king studs. Position the headers flat, with its bottom face at the marks, and secure it to the king studs with 16d nails.

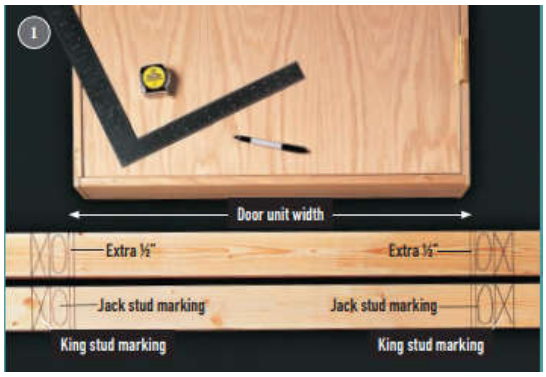


Fig 188 Step 1 Fig 189 step 2 Fig 190 Step 3

4. Cut and install a cripple stud above the header centered between the king studs. Install any additional cripples required to maintain the 16" on-center layout of the standard studs in the rest of the wall.
5. Cut the jack studs to fit snugly under the header. Fasten them in place by nailing down through the header, then drive 10d nails through the faces of the jack studs and into the king studs, spaced 16" apart.

6. Saw through the bottom plate so it's flush with the inside faces of the jack studs. Remove the cut-out portion of the plate. If you're finishing the wall with drywall, hang the door after the drywall is installed.

Fig 191 Step four

Fig 192 Step five

Fig 193 Step six

PRECAUTIONS:

- Observe safety in work place.
- Use sharp tools
- Cut timber with appropriate dimensions

QUALITY CRITERIA:

- ❖ Exactly fit frame to the door opening on the wall and
- ❖ Perfectly dimensioned to accommodate the pre-hung door

Operation sheet-10	Framing a Window opening

OPERATION TITLE: Framing Windows

PURPOSE: To construct a window frame into which a window will be fitted.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: Tape measure, Pencil, Combination square, Hammer, Level, Circular saw, Handsaw, Pry bar, Pincer, Drill, Stapler, Nail set, Caulk gun, 10d common nails, 5d galvanized roofing nails, Shims, 2× lumber, 1⁄8", plywood,10d galvanized casing nails, 8d casing nails.

Procedure:

1. Prepare the project site and remove the interior wall surfaces. Measure and mark the rough opening width on the sole plate. Mark the locations of the jack studs and king studs on the sole plate. Where practical, use the existing studs as king studs.
2. Measure and cut the king studs, as needed, to fit between the sole plate and the top plate. Position the king studs and toenail them to the sole plate with 10d nails.

Toenailing—driving a nail at an angle through the end of a board to anchor it.

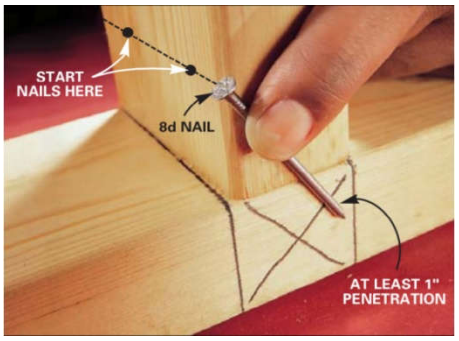


Fig 194 Toenailing

3. Check the king studs with a level to make sure they are plumb, then toenail them to the top plate with 10d nails.
4. Measuring from the floor, mark the top of the rough opening on one of the king studs. This line represents the bottom of the window header. For most windows, the recommended rough opening is 1⁄2" taller than the height of the window frame.

Fig 195 step 1

Fig 196 step 2

Fig 197 Step 3

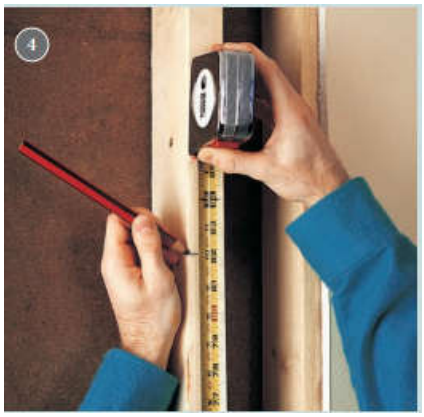


Fig 198 step 4

5. Measure and mark where the top of the window header will fit against the king stud. The header size depends on the distance between the king studs. Use a carpenter's level to extend the lines across the old studs to the opposite king stud.
6. Measure down from header line and mark the double rough sill on the king stud. Use a carpenter's level to extend the lines across the old studs to the opposite king stud. Make temporary supports if removing more than one stud.
7. Set a circular saw to its maximum blade depth, then cut through the old studs along the lines marking the bottom of the rough sill and along the lines marking the top of the header. Do not cut the king studs. On each stud, make an additional cut about 3" above the sill cut. Finish the cuts with a handsaw.
8. Knock out the 3" stud sections, then tear out the old studs inside the rough opening, using a pry bar. Remove any exposed nails, using nippers. The remaining sections of the cut studs will serve as cripple studs for the window.

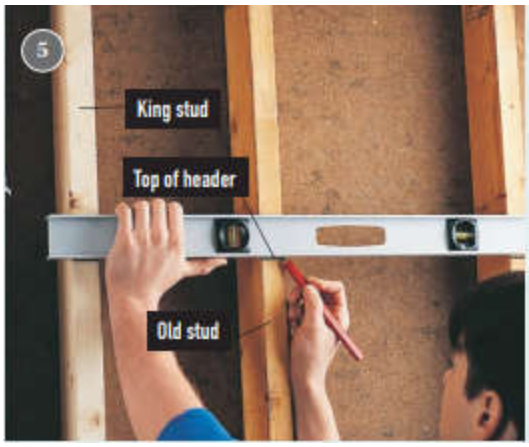


Fig 199 step 5

Fig 200 step 6

Fig 201 step 7

Fig 202 step 8

9. Cut two jack studs to reach from the top of the sole plate to the bottom header lines on the king studs. Nail the jack studs to the king studs with 10d nails driven every 12".

Note: On a balloon-framed house, the jack studs will reach to the sill plate.

10. Position the header on the jack studs, using a hammer to tap it into place if necessary. Attach the header to the king studs, jack studs, and cripple studs using 10d nails.

11. Build the rough sill to reach between the jack studs by nailing a pair of 2 × 4s together. Position the rough sill on the cripple studs, and nail it to the jack studs and cripple studs with 10d nails.

Fig 203 step 9

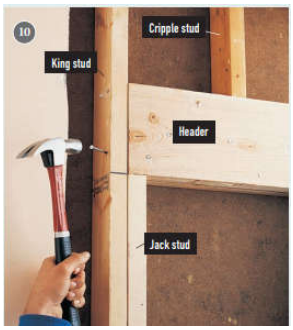


Fig 204 step 10

Fig 205 step 10

PRECAUTIONS:

- Observe safety in work place.
- Use sharp tools
- Cut timber with appropriate dimensions

QUALITY CRITERIA:

- ❖ Exactly fit frame to the window opening on the wall and
- ❖ Perfectly dimensioned to accommodate the window

Operation sheet-11	Door and window casing

OPERATION TITLE: Installing Mitered casing on doors & Windows

PURPOSE: To construct a mitered casing on door to increase the beauty of the door frame.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Tools & Materials: Tape measure, Pencil, Combination square, Nail set, Level, Straightedge, Power miter saw or miter box and backsaw, Hammer, Casing materials, 4d and 6d finish nails, Wood putty.

Procedure:

1. On each jamb, mark a reveal line 1⁄8" from the inside edge. The casings will be installed flush with these lines. On double hung windows, the casings are usually installed flush with the edge of the jambs, so no reveal line is needed.
2. Place a length of casing along one side jamb, flush with the reveal line. At the top and bottom of the molding, mark the points where horizontal and vertical reveal lines meet. (When working with doors, mark the molding at the top only).
3. Make 45° miter cuts on the ends of the moldings. Measure and cut the other vertical molding piece using the same method.
4. Drill pilot holes spaced every 12" to prevent splitting, and attach the vertical casings with 4d finish nails driven through the casings and into the jambs. Drive 6d finish nails into framing members near the outside edge of the casings.

Fig 206 step 1

Fig 207 step 2

Fig 208 step 3

5. Measure the distance between the side casings, and cut top and bottom casings to fit, with ends mitered at 45°. If the window or door unit is not perfectly square, make test cuts on scrap pieces to find the correct angle of the joints. Drill pilot holes and attach with 4d and 6d finish nails.
6. Lock nail the corner joints by drilling pilot holes and driving 4d finish nails through each corner, as shown. Drive all nail heads below the wood surface, using a nail set, then fill the nail holes with wood putty.

Fig 209 step 4

Fig 210 step 5

Fig 211 step 6

PRECAUTIONS:

- Observe safety in work place.
- Use sharp tools
- Cut timber with appropriate dimensions and shape

QUALITY CRITERIA:

- ❖ Defects at corners and edges should be fully covered and
- ❖ Perfectly dimensioned casing with good finish.

Operation sheet-12	Door and window casing

OPERATION TITLE: **Installing Butted door casings**

PURPOSE: To construct a Butt casing on door to increase the beauty of the door frame.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: Tape measure, Pencil, Combination square, Nail set, Level, Straightedge, Power miter saw or miter box and backsaw, Hammer, Casing materials, 4d and 6d finish nails, Wood putty.

Procedure:

1. On each jamb, mark a reveal line 1⁄8" from the inside edge. The casings will be installed flush with these lines.
2. Cut the head casing to length. Mark the center point of the head casing and the center point of the head jamb. Align the casing with the head jamb reveal line, matching the center points so that the head casing will either align with the outer edges or extend evenly beyond both side jamb casings. Nail the casing to the wall at stud locations and at the jamb.
3. Hold the side casings against the head casing and mark them for cutting, then cut the side casings to fit.
4. Align the side casings with the side jamb reveal lines, then nail the casings to the jambs and framing members. Set the nails, using a nail set. Fill the nail holes with wood putty.

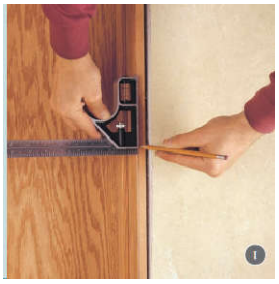


Fig 212 step 1

Fig 213 step 2

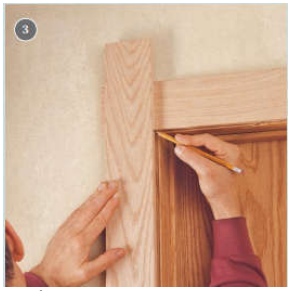


Fig 214 step 3

Fig 215 step 4

PRECAUTIONS:

- Observe safety in work place.
- Use sharp tools
- Cut timber with appropriate dimensions and shape

QUALITY CRITERIA:

- ❖ Defects at corners and edges should be fully covered and
- ❖ Perfectly dimensioned casing with good finish.

Operation sheet-13	Installing stool & apron window trim

OPERATION TITLE: **Installing stool & apron window trim**

PURPOSE: To construct window trims to decorate the peripherals of window.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: Tape measure, Pencil, Combination square, Nail set, Level, Straightedge, Power miter saw or miter box and backsaw, Hammer, Casing materials, 4d and 6d finish nails, Wood putty.

Procedure:

1. Cut the stool to length, with several inches at each end for creating the horn returns. With the stool centered at the window and tight against the drywall, shim it to its finished height. At each corner, measure the distance between the window frame and the stool, then mark that dimension on the stool.
2. Open a compass so it touches the wall and the tip of the rough opening mark on the stool, then scribe the plane of the wall onto the stool to complete the cutting line for the horn.
3. Cut out the notches for the horn, using a jigsaw or a sharp handsaw. Test-fit the stool, making any minor adjustments with a plane or a rasp to fit it tightly to the window and the walls.
4. To create a return at the horn of the stool, miter-cut the return pieces at 45° angles. Mark the stool at its overall length and cut it to size with 45° miter cuts. Glue the return to the mitered end of the horn so the grain wraps around the corner.

   Note: Use this same technique to create the returns on the apron (step 13), but make the cuts with the apron held on edge, rather than flat.
5. Where extensions are needed, cut the head extension to its finished length—the distance between the window side jambs plus the thickness of both side extensions (typically 1× stock). For the width, measure the distance between the window jamb and the finished wall at each corner, then mark the measurements on the ends of the extension. Use a straightedge to draw a reference line connecting the points. Build a simple cutting jig, as shown.

Fig 216 steps 1 Fig 217 step 2

Fig 218 step 3

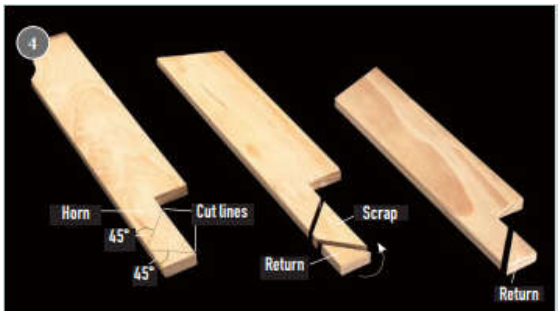


Fig 219 step 4

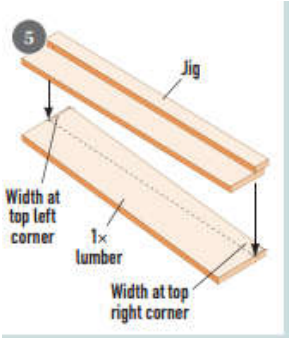


Fig 220 step 5

6. Clamp the jig on the reference line, then rip the extension to width using a circular saw; keep the base plate tight against the jig and move the saw smoothly along the cut. Reposition the clamp when you near the end of the cut. Cut both side extensions to length and width, using the same technique as for the head extension (step 5).
7. Build a box frame with the extensions and stool, using 6d finish nails and a pneumatic nailer. Measure to make sure the box has the same dimensions as the window jambs. Drive nails through the top of the head extension into the side extensions and through the bottom of the stool into side extensions.
8. Apply wood glue to the back edge of the frame, then position it against the front edge of the window jambs. Use wood shims to adjust the frame, making sure pieces are flush with window jambs. Fasten the frame at each shim location, using 8d finish nails driven through pilot holes. Loosely pack insulation between framing members and extensions.
9. On the edge of each extension, mark a 1⁄4" reveal at the corners, the middle, and the stool. Place a length of casing along the head extension, aligned with the reveal marks at the corners. Mark where the reveal marks intersect, then make 45° miter cuts at each point. Reposition the casing at the head extension, and attach using 4d finish nails at the extensions and 6d finish nails at the framing members.

Fig 221 step 6

Fig 222 step 7

Fig 223step 8

10. Cut the side casings to rough length, leaving the ends slightly long for final trimming. Miter one end at 45°. With the pointed end on the stool, mark the height of the side casing at the top edge of the head casing.

11. To get a tight fit for side casings, align one side of a T-bevel with the reveal, mark the side extension, and position the other side flush against the horn. Transfer the angle from the T-bevel to the end of the casing, and cut the casing to length.

14. Fig 224 step 9 Fig 225 step 10 Fig 226 step 11

12. Test-fit the casings, making any final adjustments with a plane or rasp. Fasten the casing with 4d finish nails at the extensions and 6d finish nails at the framing members.

13. Cut the apron to length, leaving a few inches at each end for creating the returns (step 4). Position the apron tight against the bottom edge of the stool, then attach it using 6d finish nails driven every 12"

Fig 227 step 12 Fig 228 step 13

PRECAUTIONS:

- Observe safety in work place.
- Use sharp tools
- Cut timber with appropriate dimensions and shape

QUALITY CRITERIA:

- ❖ Defects at corners and edges should be fully covered and
- ❖ Perfectly dimensioned casing with decorated finish

Operation sheet-14	Installing Base Molding

OPERATION TITLE: **Installing one-piece Base Molding**

PURPOSE: To construct a base molding to cover the joint between the walls and floor.

Conditions or situations for the operations: The learner should perform this activity with complete protective equipment and sharp tools.

Equipment tools and materials: Pencil. Tape measure, Power miter saw, T-bevel, Coping saw, Metal file set, Pneumatic finish nail gun & compressor, Moldings, Pneumatic fasteners, Carpenter's glue, Finishing putty

Procedure:

1. Measure, cut, and install the first piece of baseboard. Butt both ends into the corners tightly. For longer lengths, it is a good idea to cut the piece slightly oversized (up to 1⁄16" on strips over 10 ft. long) and "spring" it into place. Nail the molding in place with two nails at every stud location.
2. Cut the second piece of molding oversized by 6" to 10" and cope-cut the adjoining end to the first piece. Fine-tune the cope with a metal file and sandpaper. Dry-fit the joint, adjusting it as necessary to produce a tight-fitting joint.

Fig 229 step 1

Fig 230 step 2

3. Check the corner for square with a framing square. If necessary, adjust the miter cut of your saw. Use a T-bevel to transfer the proper angle. Cut the second piece (coped) to length and install it with two nails at each stud location.
4. Adjust the miter angle of your saw to cut the adjoining outside corner piece (3). Test-fit the cut to ensure a tight joint (inset photo). Remove the mating piece of trim and fasten the first piece for the outside corner joint.

Fig 231 step 3

Fig 232 step 4

5. Lay out any scarf joints by placing the piece in position so that the previous joint is tight and then marking the center of a stud location nearest the opposite end. Set the angle of your saw to a 30° angle and cut the molding at the marked location.
6. Nail the third piece in place, making sure the outside corner joint is tight. Cut the end of the fourth piece to match the scarf joint angle and nail it in place with two nails at each stud location. Add the remaining pieces of molding, fill the nail holes with putty, and apply a final coat of finish.

Fig 233 step 5

Fig 234 step 6

PRECAUTIONS:

- Observe safety in work place.
- Use sharp tools
- Cut timber with appropriate dimensions and shape

QUALITY CRITERIA:

- The underside of the walls should be well covered and
- The **baseboards** should keep water from running under your drywall and flooring.

Operation Sheet-15	Door installation

Operation title: **Installing door for buildings**

Purpose: To install doors in a finished door frames.

Conditions or situations for the operations: The trainee should perform this activity with complete protective equipment.

Equipment, tools and materials: are the following but not limited to: all personal protective equipment, Tape measure, chisel, mallet, hammer, plane, saws, screwdriver, nails, and screws.

Procedure:

1. Cut off the stile extensions, if any.

2. Plane the edges of the stiles until the door fits tightly against the hinge side and clears the lock side of the jamb by about 1/16 inch. Be sure that the top fits squarely to the rabbeted recess and that the bottom swings free of the finished floor by about 1/2 inch.

The lock side stile of the door must be beveled slightly so that the edge of the stile will not strike the edge of the door jamb.

3. After proper clearances have been made, tack (nail temporarily) the door in position in the frame and wedge it at the bottom.

4. Mark hinge positions with a sharp-pointed knife on the stile and the jamb. Hinge positions on the stile must be placed slightly higher than the lower door rail and slightly lower than the upper door rail to avoid cutting out part of the door-rail tenons that are housed in the stile. Three measurements must be marked:

- The location of the butt on both the jamb and the door,
- Thickness of the butt on both the jamb and the door and
- Location of screws on both the door and jamb.

5. Cut the marked areas, called *gains,* on the door jambs and door to fit the butts. Use a 1-inch chisel and mallet.

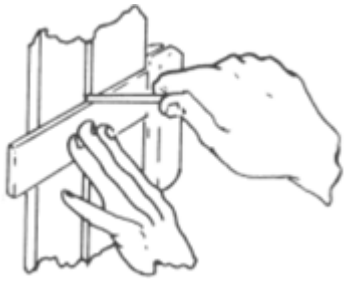


Fig 235 Scribe across jamb and door

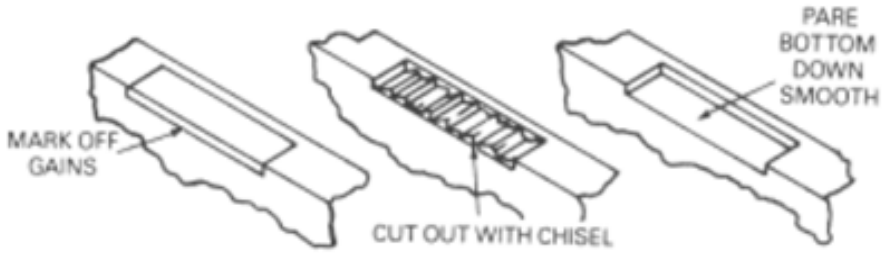


Fig 236 Cut gains for door butts

6. Test the gains. The butts must fit snugly (tightly) and exactly flush with the edge of the door and the face of the jamb.

7. Screw half of each of the butt joints on the door and the other three parts on the jamb. Place the butts so that the pins are inserted from the top when the door is hung.

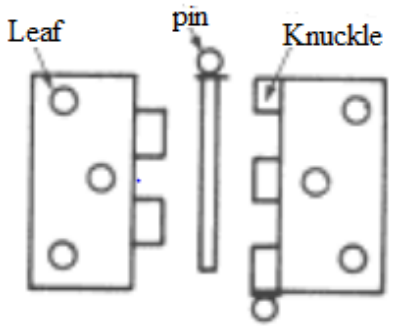


Fig 237 Insert pin from top

8.Set the door against the frame so that the two halves of the top butt engage.

- Insert the top pin.
- Engage and insert pins in the center and
- Engage and insert pins in the bottom butts.

PRECAUTIONS:

- Work in a fully protected situation.
- Use sharp tools.
- Repeatedly check before screwing the hinge.

QUALITY CRITERIA:

- The butts and mortise are placed with utmost accuracy so that the door will open and close properly, hence the door, when open, will not strike the casing.
- The butt pin must project more than half its thickness from the casing.

Operation Sheet-16	Lock installation

OPERATION TITLE: **lock installation**

PURPOSE: To install Mortise locks in finished panel doors.

Conditions or situations for the operations: The trainee should perform this activity with complete protective equipment.

Equipment, tools and materials: all personal protective equipment, Tape measure, chisel, mallet, hammer, plane, saws, portable electric drill, screwdriver, nails, screws.

Procedure:

1. **Mark Position:** Begin by determining the height of the lock on your door, 36 inches from the floor level. Hold the lock against the door with the lock face flush with the door edge. Mark the top and bottom of the keyhole. Also mark the top and bottom edges of the lock face on the door edge.
2. **Outline Lock:** Place the lock faceplate in line with the markings already made on the door edge to determine where the timber needs to be removed from the door in order to allow the body of the mortise lock to slide into the door.
3. **Drill Keyhole:** This is the first timber to be removed. To avoid damage to the front surface of the door, clamp a piece of wood to the back of the door. When the drill bit emerges (come out) from the back surface of the door, it will not tear timber fibers and spoil the surface.
4. **Chisel Keyhole:** Enlarge the hole into a slot by using the drill and hammer and chisel as necessary.

Fig 238 step 1

Fig 239 step 2

Fig 240 step 3

Fig 241 step 4

5. **Prepare Drill:** Choose a drill bit a little larger than the width of the lock housing. Drill just a little deeper than the depth of the lock. Keep in mind that the lock faceplate will ultimately be recessed into the door as well as the body of the lock.
6. **Drill Recess:** Use the drill to begin to form the mortise recess in the edge of the door to the required height and depth. Ensure the drill runs completely parallel to the sides of the door or the lock will not sit straight in the hole. Drill at 45 degrees upwards from the bottom hole and 45 degrees downwards from the top hole to reduce the amount of timber you need to remove with the chisel.

7. **Chisel Recess:** Using a hammer and chisel, enlarge the drilled holes as required. Does this step slowly, removing small pieces of timber at a time.
8. **Chisel Faceplate Recess:** When the mortise recess is the correct size insert the lock. Push the lock in until the faceplate comes up against the edge of the door. Draw around this with a pencil to show the timber that needs to be removed in order for the faceplate to sit flush with the edge of the door.


Fig 242


Fig 243


Fig 244


Fig 245

9. **Screw in Faceplate/striking plate:** Insert the lock and faceplate and screw in firmly. Check the position of the keyholes to ensure smooth operation of the key action.
10. **Fit Keyhole Covers:** Fit the keyhole covers on both sides of the door.
11. **Position striking plate/face plate:** With the door open, turn the key in the lock to extend the dead bolt fully. Close the door so that the bolt touches the door frame. Mark the position of the top and bottom of the bolt on the door frame. Measure carefully to find the correct position of the striking plate. Drill and chisel out a recess to allow the striking plate to fit flush in position.
12. **Fit striking plate:** Check the lock action with the door closed to ensure the position of the receiver/striking plate is correct, and then screw it into position.


Fig 246


Fig 247


Fig 248

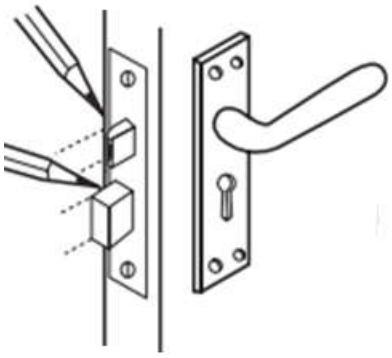


Fig 249

Fig 250

PRECAUTIONS:

- Follow OHS rules.
- Use sharp tools.
- Protect the door from damage.

QUALITY CRITERIA:

- The lock should be installed with utmost accuracy so that it can be locked and unlocked properly.

Operation Sheet-17	Replacing a Broken Window Pane

OPERATION TITLE: Replacing a Broken Window Pane

PURPOSE: To remove broken window glass and replace it with a new one.

Conditions or situations for the operations: The trainee should perform this activity with complete protective equipment.

Equipment tools and materials: all personal protective equipment, Tape measure, glass cutter, plier, putty knife, heat gun (optional), scraper, brush, sand paper, primer (anti-rust paint), glazier's point, .

Procedure:

1. Remove the broken pane (glass panel) from the window. It may help to use pliers to pull out pieces of glass that are still in the window frame.
2. Scrape off the old putty with a putty knife and heat gun. The heat gun will help to soften the putty.
3. Pry (lever up) the old metal glazing points out of the "rabbets."
   - **Rabbets** *are the "L" shaped grooves in which the glass sits.*
4. Scrape and sandpaper the rabbets until they are smooth, bare wood. Then, brush them with an exterior primer.
   - **Primer** ***is a substance used as a preparatory coat on wood, metal, or canvas, especially to prevent the absorption of subsequent (following) layers of paint or the development of rust.***
5. Press new putty into the rabbets once the primer dries.
6. Set and center a new pane (glass panel) into the putty. There should be about 1/8 inch (3 mm) of putty between the face of the glass and the rabbet
7. Install a glazier's point to hold the glass in place.
   - **Glazier Points** ***hold glass in sash or wooden frames and can be inserted with a putty knife.***
8. Turn the sash over and scrape off the putty that has squeezed out to that side.
9. Knead (mold) and warm a handful of putty into a long rope that is about 3/4 inch (19 mm) in diameter.
10. Set the putty rope around the edges of the glass on each side. Press it firmly against the rabbets. Spread and smooth out the putty with a putty knife.[5]
11. Remove the excess putty and repeat the process for each side.
12. Wait 7 to 10 days for the putty to stiffen. Then, use a clean rag to wipe away any putty film that's left on the glass.
13. Paint the putty with an oil-based primer.

14. Apply a coat of exterior paint once the primer dries.

15. Wash the pane.

PRECAUTIONS:

- Before any work begins, you must wear either safety glasses or goggles and leather gloves.
- Dispose of the broken glass pieces appropriately.
- Cut the glass with extreme care

QUALITY CRITERIA:

- The fixed glass pane should not move, no cracks seen in the glass pane and window pane cleared from remnants of paint and putty.

Operation Sheet-18	How to cut glass

OPERATION TITLE: Cutting window glass

PURPOSE: To cut glass to be fitted into window frame

Conditions or situations for the operations: The trainee should perform this activity with complete protective equipment.

Equipment tools and materials: all personal protective equipment, Tape measure, glass cutter, Cutting oil (or Kerosine).

Procedure:

Part 1 Preparation

1. Set up your work area**.** You'll need a large flat surface, preferably one that is slightly soft and won't scratch your glass. Work in an area that is easy to clean.
2. Clean the glass surface in the area where you plan to make cuts.
3. Obtain a glass cutter and some light oil. If you cannot get cutting oil use a small amount of kerosene.

Fig 251 step 1

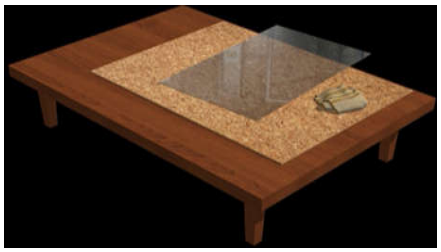


Fig 252 step 2

Fig 253 step 3

4. Measure and mark where you want to score**.** The score must run from one edge of the glass to the other edge. You can write on the glass with a marker, preferably with a straight edge, if you are cutting a straight line. You can also mark on paper and place the glass on top of the paper.

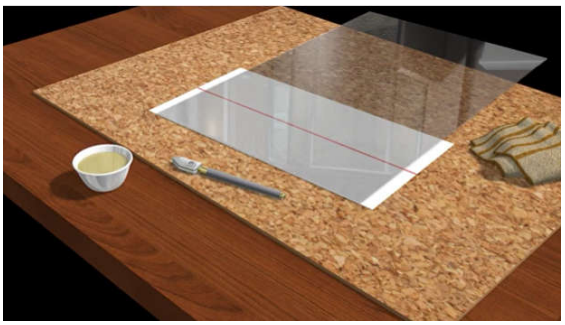


Fig 254 step 4

Part 2 Scoring the Glass

1. Dip the cutter in the oil and grasp it like a pencil.

2. Lay out a straight edge.

3. Apply pressure to the glass and you pull the cutter along the surface, rolling on the small carbide wheel.

- If you push too hard (a very common mistake), your cut gets "hot," meaning that it snap (break) and pops (cracks).

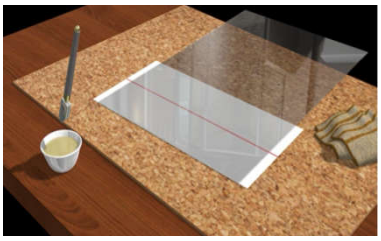


Fig 255 step 1

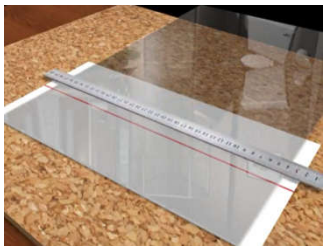


Fig 256 step 2

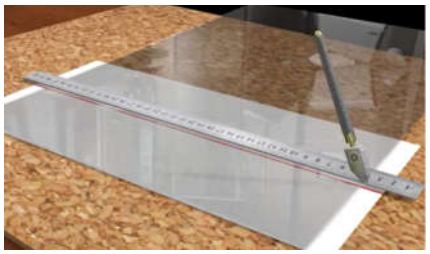


Fig 257 step 3

4. **Run the cutter smoothly from one edge to the other.** Do not run back and forth over the line if you miss a spot.

Fig 258 Glass Cutter

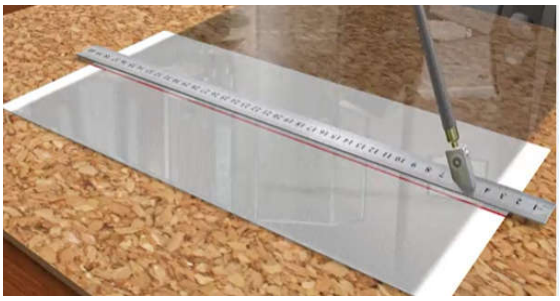


Fig 259 Step 4

5. Check your score**.**

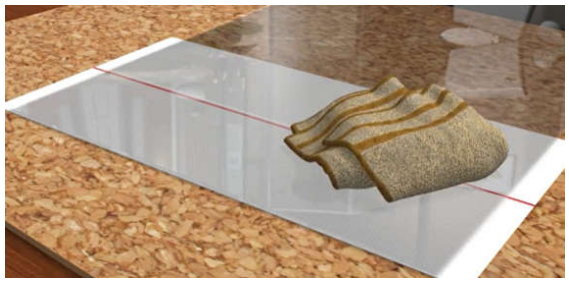


Fig 260 Clean the surface with fine cloth to check the cut

Part 3 Breaking and Smoothing:

1. Grasp each side of the cut carefully in your hands.

2. Apply minor pressure from the wrist to break the glass along your score**.** Your elbows do not move. Simply twist your wrists.

3. Use fine sandpaper or a sharpening stone to remove the sharp edge.

Fig 261 step 1

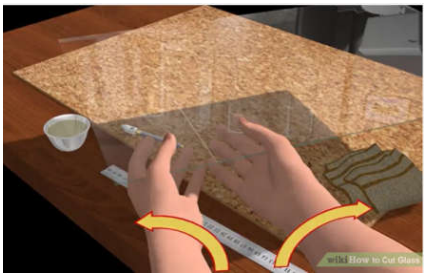


Fig 262 step 2

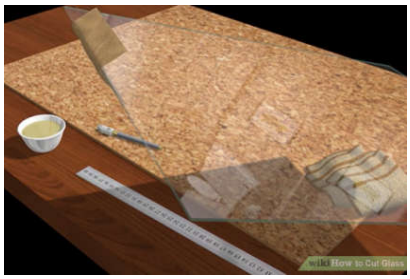


Fig 263 step 3

***To know how to cut glass in a straight line or curve on glass, refer this website on the internet*:** https://www.wikihow.com/Cut-Glass

PRECAUTIONS:

- Avoid working over carpet because of the risk of getting glass shards (debris) on the floor if the glass breaks.
- Cut should not be very long. Scores longer than two feet have a high failure rate when breaking.
- Dispose of the broken glass pieces appropriately.

QUALITY CRITERIA:

- Make sure your marks leave about six inches of glass on each side to grip and break. If you cut smaller pieces, you may need to use special tools, like pliers or a light hammer, to break off glass you can't get a hold of.

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