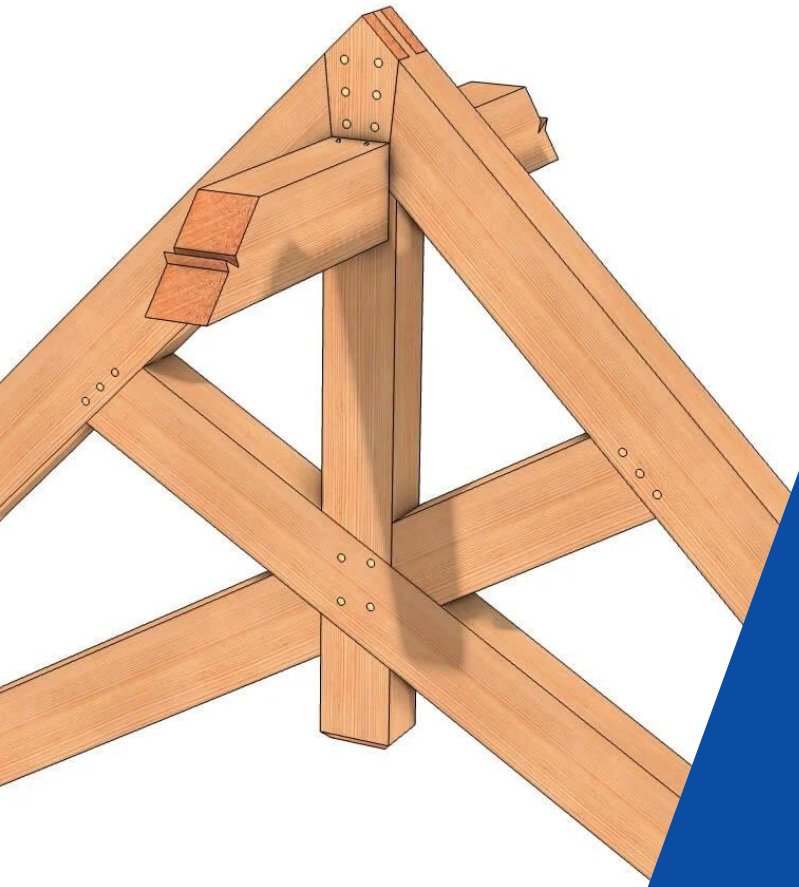
CONSTRUCTION OF WOOD WORKING JOINTS APPLICATION AND MANUFACTURING OF ENGINEERING WOOD PANELS AND BEAMS



WOOD TECHNOLOGY

TRAINING MANUAL

November, 2022.

CONSTRUCTION OF WOOD WORKING JOINTS APPLICATION AND MANUFACTURING OF ENGINEERING WOOD PANELS AND BEAMS

Implemented by

2022

ACKNOWLEDGEMENT

Rwanda TVET Board **(RTB)** and Rwanda Polytechnic **(RP)** would like to recognize all parties who contributed actively to the preparation of this training manual that was developed under **the GIZ Eco-Emploi Programme**.

We wish to extend our thanks to **GIZ/GOPA** for the valuable financial and technical support throughout the implementation of this project.

We would like to express our sincere gratitude to various institutions (public and private) for their valuable support during the development of this training manual.

We would also wish to acknowledge different experts from public and private institutions for their huge contribution to the development of this training manual.

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ABBREVIATION

Hi-ATB: High Alternate Top Bevel

MDF: Medium Density Fibreboard

OEE: Overall Equipment Effectiveness

RCD: Residual Current Device

RPM: Revolutions Per Minute

TCG: Triple Chip Grind

LEARNING UNIT 1: MAINTENANCE

1.1 Introduction

The goal of maintenance is to eliminate or to avoid unnecessary or unplanned downtime due to failure, to ensure the reliability and safety of plant equipment. Knowing that all equipment components will wear, appropriate man-agreement must be applied to avoid unplanned failure.

Maintenance can influence the entire plant operation, from product quality to on-time delivery, to safety records and to the impact of environmental pollutions. Poor maintenance procedures can cost some company millions of Rwandan francs in repairs, poor quality and lost production, whereas good maintenance practices can cut production costs immensely. Still the advantages of maintenance management are underestimated.

Here are some samples on how we handle other common situations in life:

- We go to the doctor only when we are sick
- Our car goes into the shop only for repairs
- In our home, we call electricians, plumbers, etc. only when there is a problem
- The focus of technical education is on dismantling/reassembling equipment
- In the workplace, the best "fixer" gets the promotion

This “bad habits” has integrated itself into the maintenance workplace also. It is unlikely that these "habits" can be changed overnight. Moving from the approach of "Fixing" as the principal activity of maintenance to the approach of “Preventive Management” - which is proactive - takes time, and a good engineering.

UNIT 1: BASICS OF WOOD WORKING JAOINTS

1.1. Introduction woodworking joints and engineered wood products

The application of joints is a key part in making of products out of wood and wood based materials.

In some countries, trade is even named after this technique. Joinery is a part of woodworking that involves joining pieces of wood or lumber to produce more complex items.

Depending on the purpose of the construction, the joints are made with: fasteners, bindings, or adhesives while others use only wood elements.

The characteristics of wooden joints:

Strength, flexibility, toughness, appearance, etc..

Characteristics of wooden joints also depend on the properties of the materials involved and the purpose of the joint.

Therefore, different joinery techniques are used to meet differing requirements. For example, the joinery used to construct a house can be different from that used to make furniture. The woodworking joints itself is the connection between wooden parts that make up the structure of a piece.

Many wood joinery techniques take into account or compensate the fact that wood is anisotropic: this means that wood properties are different along different dimensions. This must be taken into account when joining wood parts together. Gluing boards with the grain running perpendicular to each other could be the reason for failure, or broken joints.

In modern woodworking, it is even more critical, as heating and air conditioning cause major changes in the moisture content of the wood. All woodworking joints must take these changes into account and allows for the resulting movement.

A movement just by 1% results in dimensional changes that will create cracks and bending of surfaces. In this course the main emphasis is to learn and to apply various techniques to improve the construction and the quality of wooden products.

1.2 Selecting the right joint

Various aspects need to be considered to choose the right joint:

- How will the joint be used? (door/window/chair/cabinet, dismantle/permanent
- What kind of materials will be used? (solid wood/wood-based panels)
- How durable does it need to be? (What kind of load has the joint to support)
- What appearance is required? (visible/invisible/decorative)
- How many joints need to be made?
- How skilled is the craftsman?
- What special tools are needed to make and clamp the joint? (hand tools, machinery, fixtures)

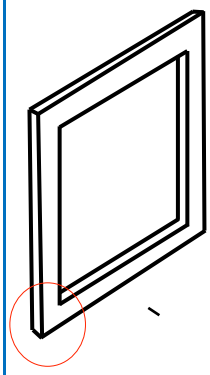
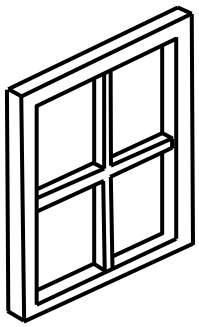
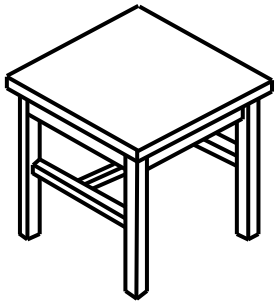
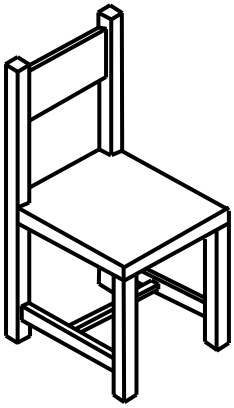
Approach of this workshop:

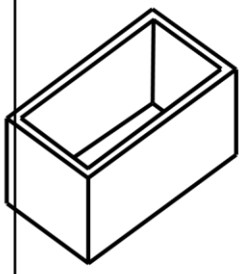
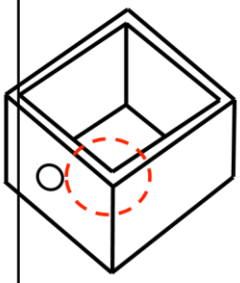
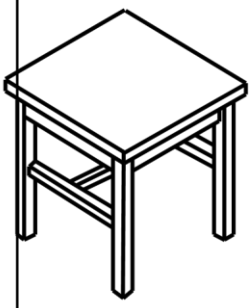
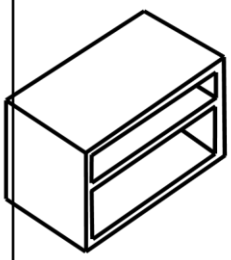
The joints are categorised according to their common constructions. Joints highlighted with this symbol will be covered in details and with practical exercises. The detailed drawings are in Chapter 9 *Exercises*

2. Wood working joints for solid wood: Edge to edge joints for solid wood
3. Wood working joints for solid wood: Frame Joints
4. Wood working joints for solid wood: Carcass Joints
5. Wood working joints for engineered wood panels
6. Knock-down joints

The suitability of the joints is indicated for various projects.

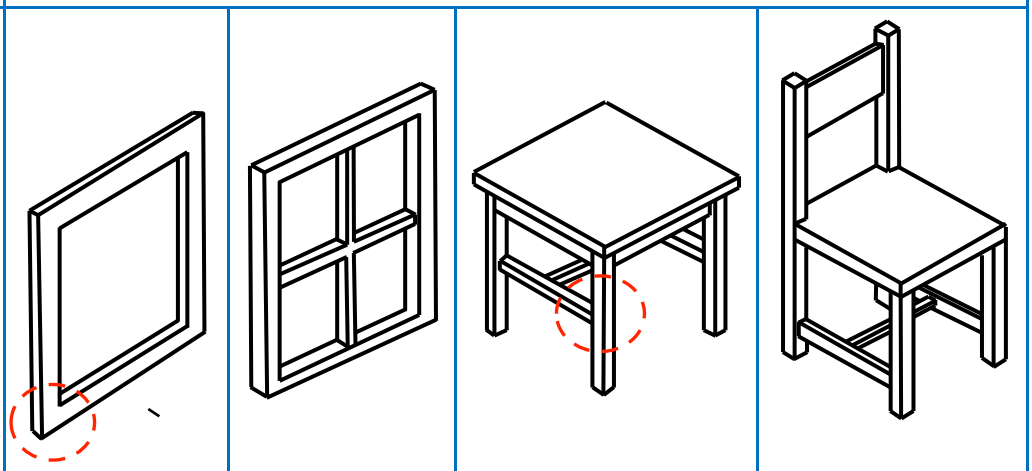
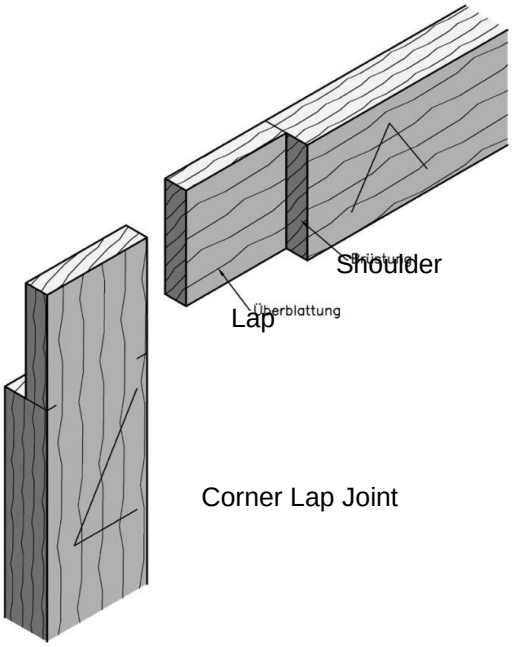
The applications are indicated by the following symbol:

Application:				
				
	Frame	**Window Frame**	**Table**	**Chair**

Application:				
				
	Box	**Drawer**	**Table Top**	**Cabinet**

Additional Information for the joints is provided at the first page of each chapter.

Sample: Half Lap Corner Joint

Description:	**Simple Corner Joint, useful for simple corner and cross joints**
Application:	
Illustration:	 Corner Lap Joint

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**Medium**	**Easy**
Plywood	**/**	**/**	**/**
Block board	**/**	**/**	**/**
Chipboard	**/**	**/**	**/**
MDF	**/**	**/**	**/**

1.3 Selecting the timber and boards

The quality of the products and the joints depend on the proper grading and selection of the wood.

Timber is a natural product, and every natural product has some imperfections. Most of the defects in timber cause weakness or other sorts of difficulties. The main reasons for defects include:

- Defects due to natural forces
- Defects due to attack by insects
- Defects due to fungi
- Defects due to poor seasoning
- Defects due to poor conversion

Defects in Timber due to Natural Forces

- **Knots:**

  Knots are the most common defects caused due to natural forces. During the growth of a tree, branches close to the ground or lower branches die. Bases of those branches remain in the tree as the trees grow. These bases do create knots in the timber.

- **Dead knots:**

  The remains of damaged branches after drying out they become loose and fall out. They are causing problems for the project.

- **Live knots:**

  They are sound and firm. If they are small, it can be accepted, depending on the grading. **Live knots are usually not a problem as they remain firmly attached to the timber.**

- **Effects:**

  Dead knots are loosely attached and reduce strength. Knots decrease the strength of the wood and thus lower its value for structural uses. Knots cause serious defects when the load is perpendicular to the grains.

- **Twist:**

The timber rotates along the grain in opposite directions. The main reason behind this defect is twisting of the trees by the strong wind or other condition during the grooving of the tr

- **Cracks/Splitting:**

  Defects that occur around the annual ring or growth ring of a timber. It could be a structural problem depending upon depth and use.

  The main problem is aesthetic. Where the appearance is important, cracks need to be sorted out.

1.3.1 Defects in Timber due to Defective Seasoning

Poor seasoning causes serious defects in woods. Stress is developed due to the difference in shrinkage. In a perfect seasoning process, stress is kept minimum by controlling the shrinkage. Following defects resulting from defective seasoning, common are:

Bow:

The bending formed in direction along the grain of the timber is called bow.

Cup:

The bending formed in the direction across the grain of the timber is called a cup.

Check:

Check is a kind of crack that separates fibers, but it doesn't extend from one end to another.

Split:

Split is a special type of check that extends from one end to another.

Honey Combing:

Stress is developed in the heartwood during the drying process or seasoning. For these stresses, cracks are created in the form of honeycomb texture.

1.3.2 Wood-based Panels

Wood-based panels like:

- Plywood
- Block board
- Middle density Fibreboard
- Particle Board do not suffer from the same defects as solid wood. Their properties are more homogeneous but are not suitable for frame joints or other applications.

For panel furniture and boxes for example wood-based panels are suitable but require different kinds of construction and joints.

1.4 Workshop safety

Woodworking shops can be dangerous. There are blades, cutting edges, shapers and even hand tools which do not distinguish between wood and human body parts. These guidelines are not all inclusive but should offer a basic understanding and awareness for shop safety.

In the appendix 1 you will find Safety Instructions for various woodworking machines from the Health and Safety Executive in the UK.

https://www.hse.g.ov.uk/woodworking/index.htm)

Important safety rules in the workshop!

- ⚠ Always wear safety glasses or goggles.
- ⚠ Wear dust masks when required.
- ⚠ Wear hearing protection
- ⚠ Use gloves to protect hands from splinters when handling wood but do not wear them near rotating blades and other machinery parts where the gloves can catch.
- ⚠ Wear protective footwear when required.
- ⚠ Use safety guards at the machines
- ⚠ Make sure the guard is in position, is in good working condition, and guards the machine adequately before operating any equipment or machine.

- ⚠ Check and adjust all other safety devices.
- ⚠ Check that keys and adjusting wrenches are removed from the machine before turning on the power.
- ⚠ Inspect stock for nails, staples, loose knots or other defects before cutting, planing, routing or carrying out similar activities.
- ⚠ Make sure that all machines have start and stop buttons within easy and convenient reach of an operator.
- ⚠ Start buttons should be protected so that accidental contact will not start the machine.
- ⚠ Ensure that all cutting tools and blades are clean, sharp, and in good working condition so that they will cut freely, not forced.
- ⚠ Turn the power off before inspecting, changing, cleaning, adjusting or repairing a blade or a machine.
- ⚠ Use a "push stick" to push material into the cutting area.
- ⚠ Keep hands out of the line of the cutting blade.
- ⚠ Clamp down and secure all work pieces when drilling, sanding, cutting or milling.
- ⚠ Use good lighting so that the work piece, cutting blades, and machine controls can be seen clearly.
- ⚠ Ensure that the floor space around the equipment is sufficient to enable you to machine the size of work piece being processed safely without bumping into other workers or equipment.
- ⚠ Use extension tables or roller supports for large work pieces.
- ⚠ Supports should be placed on both sides (infeed and outfeed).
- ⚠ Woodworking machines should be fitted with efficient and well-maintained local exhaust ventilation systems to remove sawdust or chips that are produced.
- ⚠ Electric power cords should be above head level or in the floor in such a way that they are not tripping hazards.
- ⚠ Keep work area free of clutter, clean, well swept, and well lit.
- ⚠ Spills should be cleaned up immediately. Floor areas should be level and non-slip.
- ⚠ Keep the area free from water and moisture.

⚠ Do not use electrical equipment outdoors in the rain.

⚠ Always keep your attention on the work.

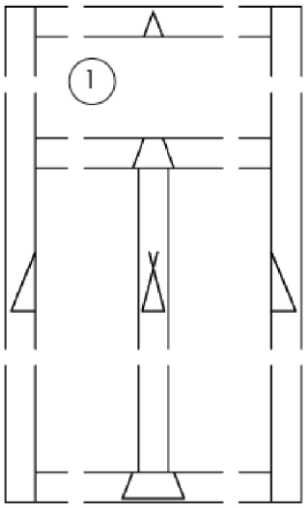
1.5 Basics of marking out

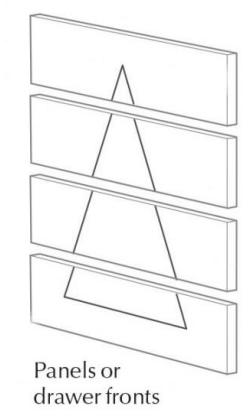
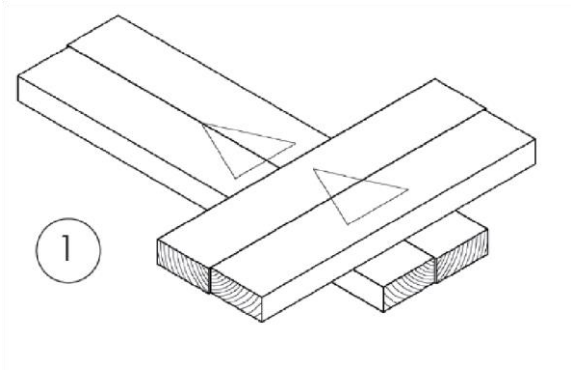
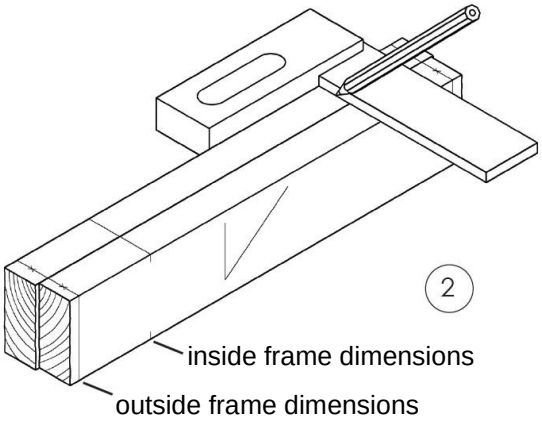
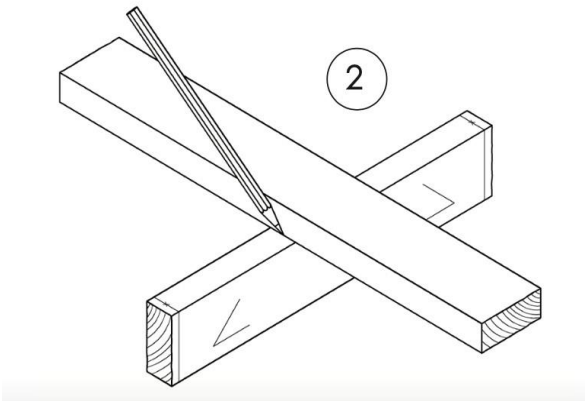
There are different ways to mark out and to cut a joint.

After knowing the basic steps in marking out woodworker variations that make the job easier or produce a better result are optional. Nevertheless, there are basic procedures and techniques that are mandatory.

The old approach, “measured twice and cut once” is good advice. If the marking is inaccurate the joints and our projects will develop problems and lack of quality. The following notes are based on the metric system of measurement.

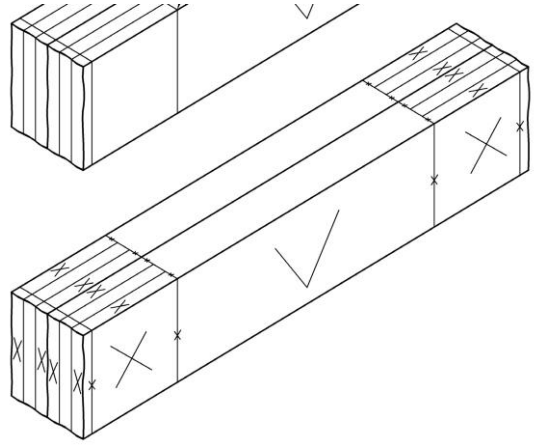
Mark out overall dimensions with a sharp pencil, not with ball pens or other kinds of pens. A marking knife to score lines that are to be cut are an additional option, it will avoid rough edge of torn wood fibres. Always run the flat face of the knife against the try square or straightedge. Use a sharp pencil to emphasize a knife line that is difficult to see.

1) Get the parts organized and marked with the triangle system. Keeping project parts organized and in proper relation to one another. Once you have dressed your work pieces to thickness, width, and length, orient them and mark the faces with sections of triangles. This quickly identifies the face, top, bottom, left and right sides of a project.	

Panels or drawer front  	Frame Parts 
2) Extending marked lines When cutting shoulder lines all around a piece of wood, locate the point of the mark, then slide the try square up against the blade and extend the marking around the work piece.	
3) Marking one component from another Whenever possible mark one component from another rather than relying on measurements.	

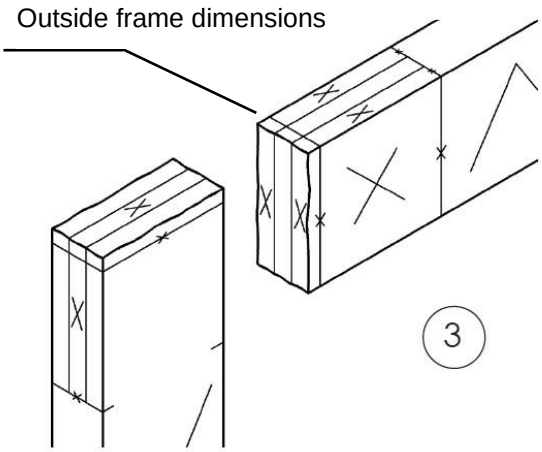
4) Marking identical components

If an assembly includes several identical components lay them together on the bench and mark them out at the same time



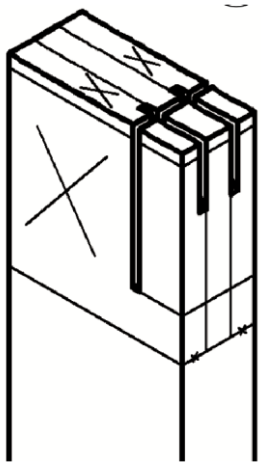
5) Cutting oversize

When making certain joints, it is good practice to deliberately leave specific elements oversize so that they can be planed flush once the glue has set - the end of a through Tenon, for example, or the tips of through dovetails and finger joints.



6) Cutting on the waste side

Allow for the width of a saw cut (the kerf) by always cutting on the waste side of any marked line. Mark the Waste with an **X** to avoid cutting on the "wrong" side.

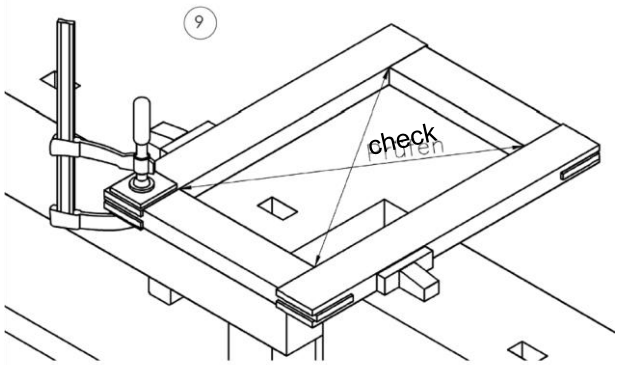


7) Making a dry assembly

Identify each joint with pencil marks so that there is no confusion when it comes to gluing the assembly.

Make sure that the shoulders meet perfect

Do not force a tight joint and risk splitting the wood.



1.6 Basics of clamping

When gluing up any project, you just have few minutes before the glue is getting cured. Therefore, avoid delays that could lead to complications, especially when using a fast-setting adhesive.

The following steps are helpful:

i. Prepare the work area

ii. Make a dry assembly, assemble the parts without glue to work out how many cramps you need

iii. Rehearse the procedure in advance.

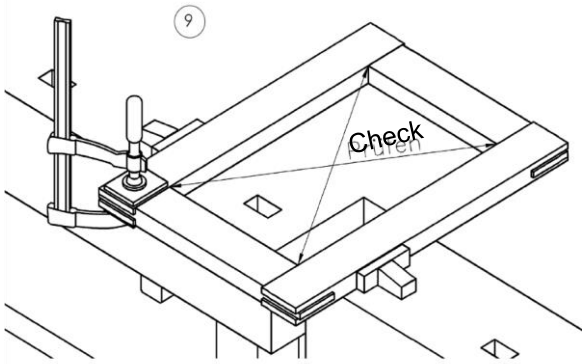
iv. Get a helper when clamping large or complicated assemblies

- It isn't necessary to glue every joint at once. Some projects can be glued step by step.

Clamping a frame

Most of the frame need clamping to hold the assembly square until the glue sets.

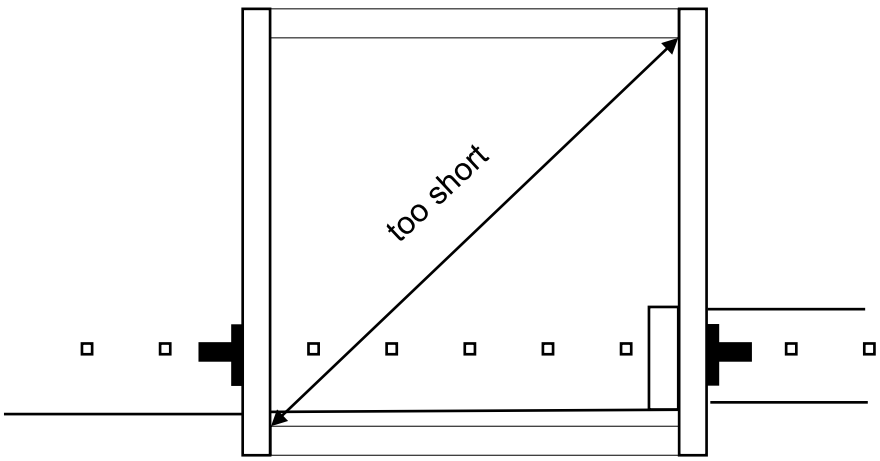
- Prepare a pair of sash or pipe cramps, adjusting them so that the assembled frame fits between the jaws
- Use softwood blocks to protect the work from the metal cramp heads



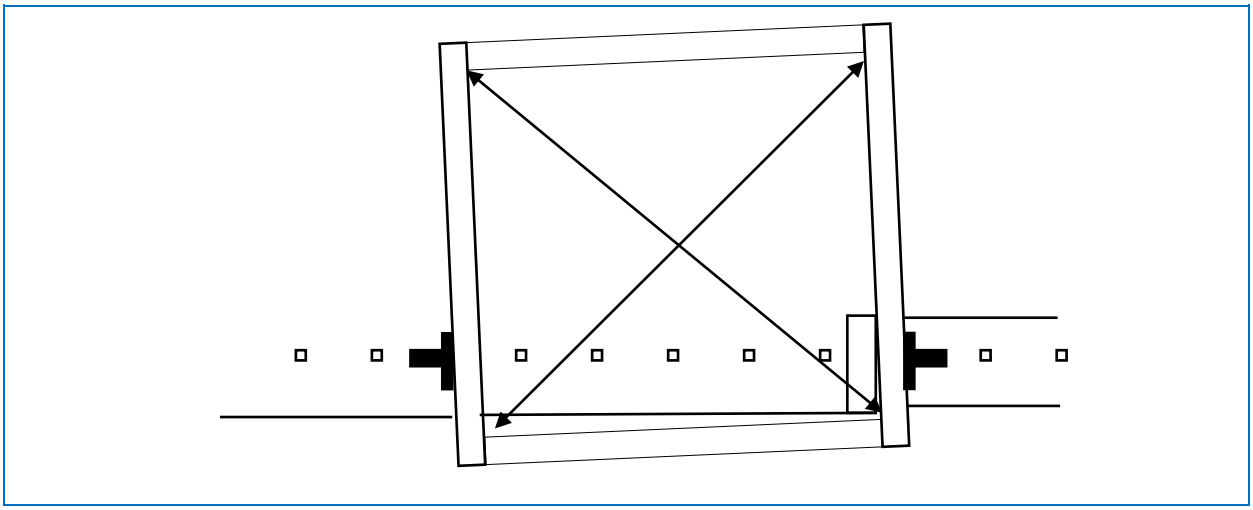
• Carefully position the blocks to align with each joint - a misplaced or undersize block can bruise the wood. • Apply adhesive evenly to both parts of each joint. • Assemble the frame, ensuring that the cramps are perfectly aligned with their respective rails, and gradually tighten the jaws to close the joints. • Wipe off excess adhesive squeezed from the joints, using a damp cloth	

Checking for square

Holding the pinch rods together firmly, lift them out of the frame and check to see if they fit the other diagonal exactly. If the diagonals are different, slacken the clamps and set them at a slight angle to pull the frame square, then check the diagonals again.



Slacken the cramps, set them at a slight angle to pull the frame square



1.7 Gluing

Consideration when choosing the most suitable glue are:	
Flexibility/Creep A little plasticity is necessary to allow for some wood movement but slipping or stretching (often the result of constant long-term loads) that doesn't move back is called creep. In smaller projects, creep means visible glue lines and laminations that lose their shape. In larger structures, creep can spell joint failure. Therefore, this would be dangerous for construction beams or parts which have to bear big loads for a long time.	
Not to be used:	PVA glue. It creeps the most. Heat and moisture will increase the movements and creep
Good to be used:	• Urea formaldehyde • Melanin formaldehyde • Epoxy • Polyurethane only for non-structural projects

<table>
<tr><td colspan="2">Toxicity
Some glues have some toxic components. Check the material safety data sheet. Use safety equipment like:
✓ gloves
✓ respirators
✓ goggles
✓ good ventilation
✓ (If in doubt, get a Material Safety Data Sheet [MSDS] from the manufacturer.)</td></tr>
<tr><td>Critical:</td><td>• Urea or melanin formaldehyde. It contains formaldehyde, a skin and lung irritant, and possible carcinogen.
• Polyurethane and epoxies contain sensitizers that can trigger allergic reactions.</td></tr>
<tr><td>Non-Toxic:</td><td>PVA Glue. It is nontoxic and can be cleaned up with water.</td></tr>
</table>

<table>
<tr><td colspan="2">Speed of curing
Working Time, open time, working time, and curing time all relate to how long it will take to glue up a project from application to maximum bonding. Depending on the project, speed can be an advantage or a disadvantage. Complicated gluing like chairs with many parts require more time than projects with few parts.</td></tr>
<tr><td>Fast:</td><td>Hot melt glue and hot hide glue cures in minutes.
Fast-curing epoxies or PVA cure in minutes, and offer considerable strength with PVA high temperatures is speeding up the cure.</td></tr>
<tr><td>Slow</td><td>Polyurethane allows a comfortable working time for complicated glue-ups but keep the clamps on until final cure or the foam can cause joints to open.
PVA is a good compromise.</td></tr>
</table>

	Always check the technical data sheets.

Temperature Sensitivity	
Gluing in cold conditions often leads to glue failure. If the temperature drops below a certain point, or if the stock was cold to start with, some glues can't cure. With PVA this temperature is 4° C. Avoid: PVAs. Most of these require a temperature above 50° F to work. When yellow glue dries white, it means that the temperature fell below the glue's chalk temperature and that the joint will likely fail.	
Critical	PVAs. Most of these require a temperature above 10° C to work.

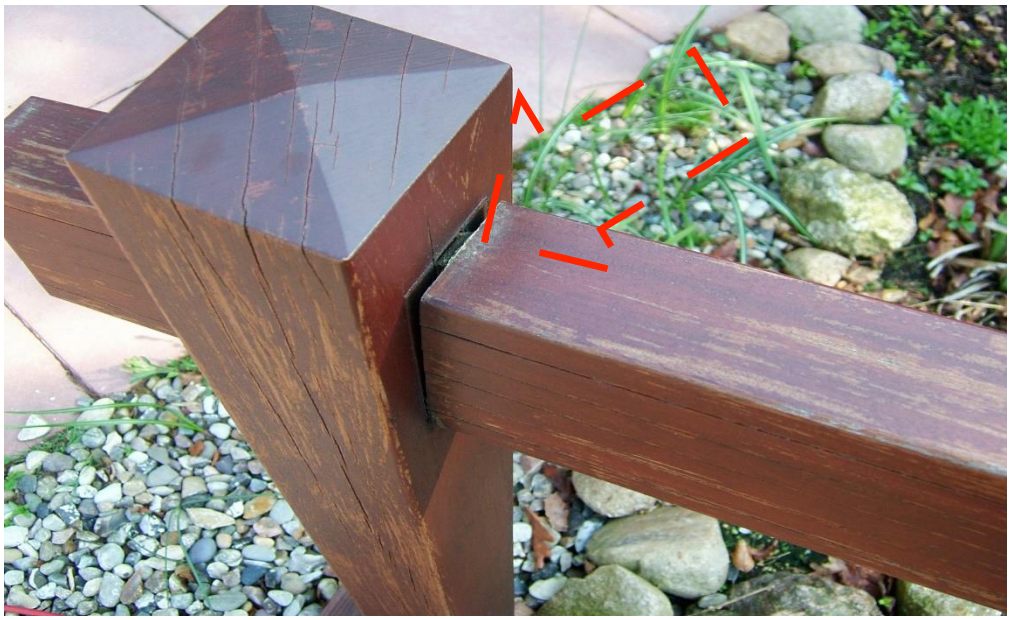
Water-Resistance	
There are different water resistances testing standards. The tests will differentiate between: **Waterproof (Type D2) according to DIN EN 204** **Water-resistant (Type D3)** **Constant immersion (Type D4)**	
Critical:	PVA Glue (hot water)
Better:	Polyurethane Urea formaldehyde Melamin formaldehyde Phenolic formaldehyde

Timekeeping
In the process of gluing, it is important to keep certain time settings. They are specified in the technical data sheets

Pot life:	The maximum amount of time you have to apply two-component glues to your work after they have been mixed
Open time:	The maximum amount of time glued pieces can be left open to the air before assembly.
Clamp time:	The minimum amount of time required before you can remove the clamps from a glue-up
Cure time:	The time it takes for a glue joint to achieve full 100% bonding strength.
Shelf life:	The period of time that glue remains useable. (Note: Excessive heat, humidity, or repeated freeze/thaw cycles will cause glues to spoil prematurely.

Glue failures along the grain

Glue failures with joints



UNIT 2: WOOD WORKING JOINTS FOR SOLID WOOD: EDGE TO EDGE JOINTS FOR SOLID WOOD

2.1 Edge-to-edge Butt Joint

Timber selection is very important for edge-to-edge joints when making a wide panel from solid wood. To ensure that the panel will remain flat, the selection according to the annual rings is important.

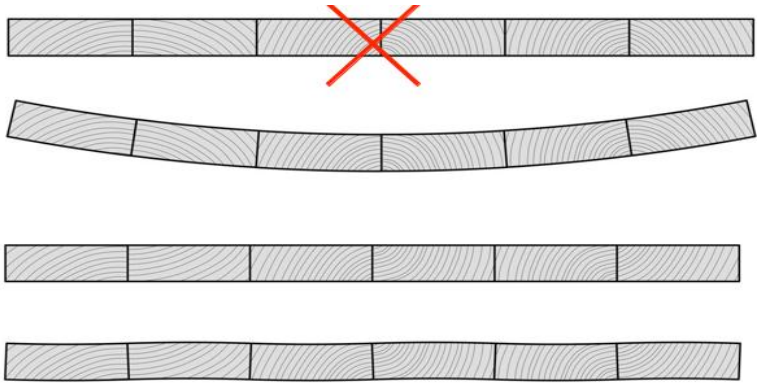
Criteria's for the arrangements of the parts:

Use quarter-sawn wood – that is, with the end-grain growth rings running perpendicular to the face side of each board.

Arrange the directions of ring growth alternating from on board to the next.

Ensure that the surface grain on all boards run in the same direction, to make final cleaning with a plane easier.

Select and mark the face side of each board.



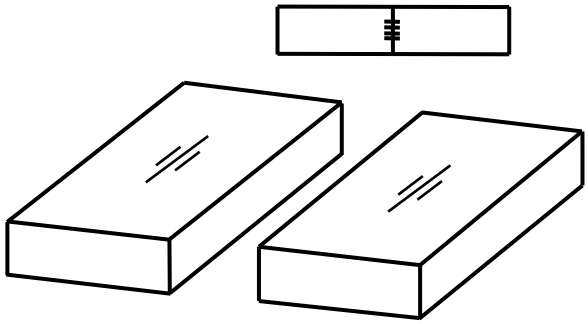
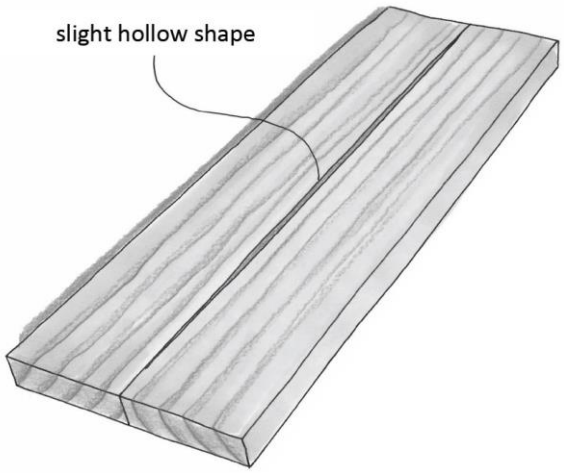
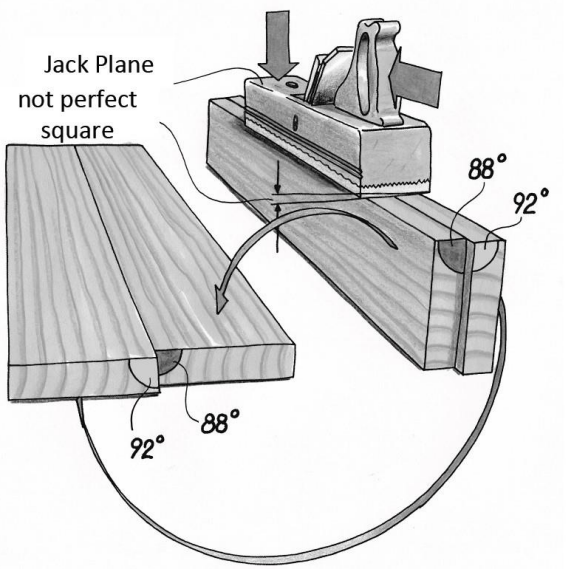
① Shape after gluing before drying
② Shape after drying
③ Shape after gluing before drying
④ Shape after drying

①

②

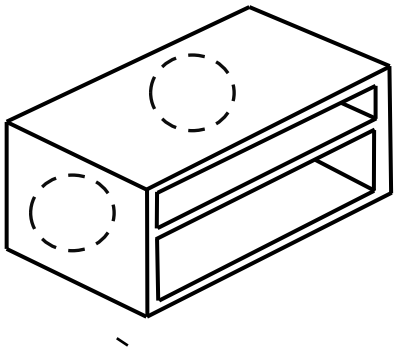
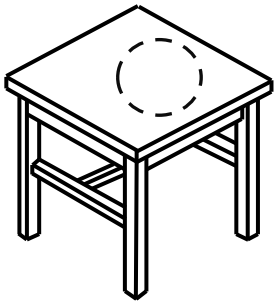
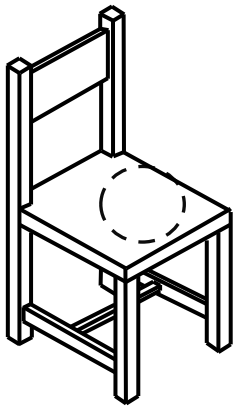
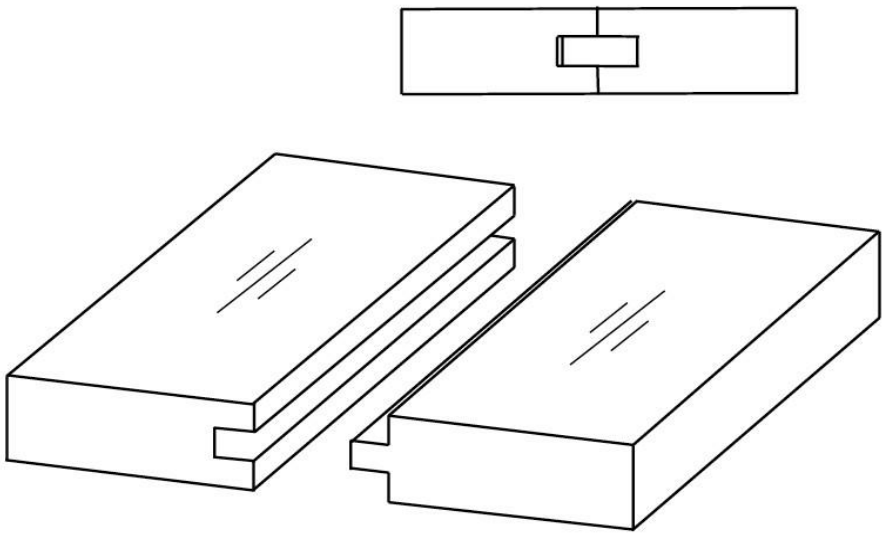
③ ✓

④

1) Planing edges square With the face sides on the outside, set both boards back-to-back and level in a vice. Plane the edges straight and square, using a jack plane.	
2) Checking for straight edges It is important that the edges are straight. Checking them by using a metal straightedge and a try square. If the boards are to be clamped together, a very slight hollow shape is acceptable.	
3) Matching edges Plane the boards as a matching pair. It will fit together and produce a flat surface, even when the edges are not exactly square.	

4) Clamping joints • Before adding glue, make a dry assembly. • Use softwood to protect the edges from bruising. • After gluing check for a flat surface	

2.2 Tongue-and-groove Joint - Overview

Description:	**Edge joint to reinforce the strength of the joint along the glue line.**		
Application:			
Illustration:			

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**Difficult**	**Easy**
Plywood	**Good**	**/**	**Easy**
Block board	**Good**	**/**	**Easy**
Chipboard	**Good**	**/**	**Easy**
MDF	**Good**	**/**	**Easy**

For gluing boards together edge to edge with tongue and groove the glue-surface is getting bigger. Therefore, the joint becomes stronger.

Tongue and groove joints allow two flat pieces to be joined strongly together to make a single flat surface.

This joint can be applied with solid wood and wood-based panels. Using machinery allows a fast and precise making of the joint.

Make sure that the tongue is 1-2 mm shorter than the depth of the groove.

Advantages:

- Improves strength of the joint
- Provides guidance when gluing

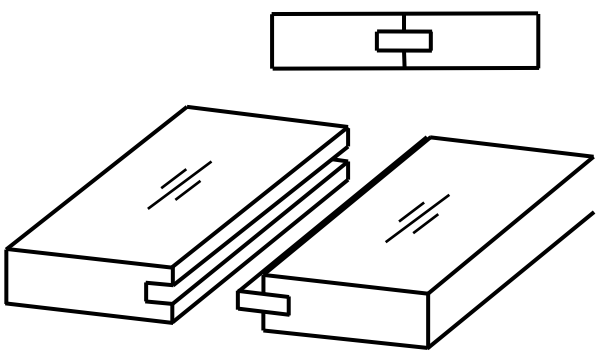
Disadvantages:

- Difficult to make with hand-tools

Loose Tongue-and-Groove Joint

A loose tongue has some advantages compared to the tongue and groove joints using an integral tongue.

- No material losses in width of the boards for the tongue.
- Only one machine setting, and one tool is needed.
- Tongue can be made from plywood or solid timber.

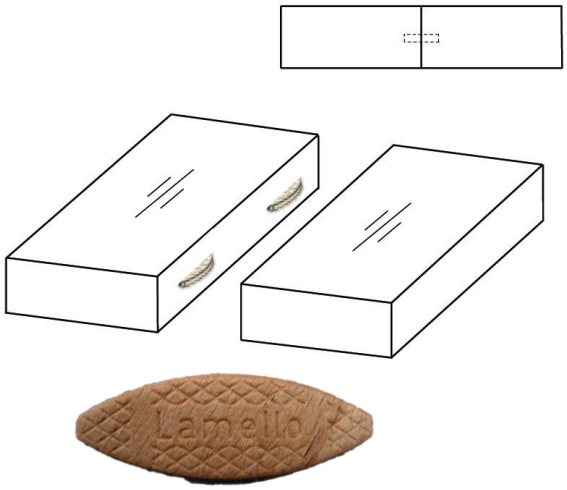


2.3 Biscuit Joint/Dowel Joint

Biscuit Joint

- The joint requires the use of only one hand machine tool
- It is fast and efficient
- Provides guidance when gluing
- More glue surface for panel assembly

(See also chapter 5)



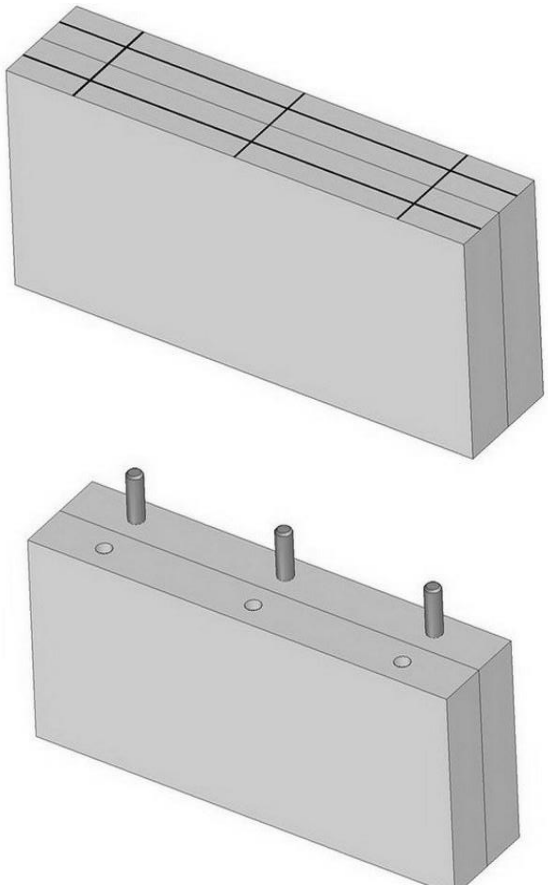
Dowel Joint

This joint is very simple in construction, but not easy to make.

It must be done very precisely in marking and making. Jigs and templates are useful to prepare accurate drillings.

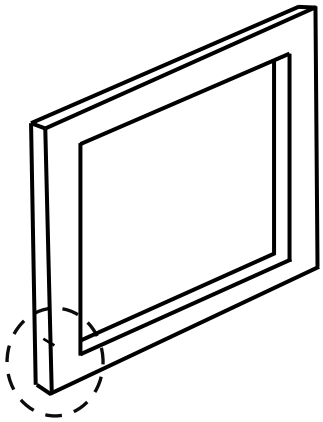
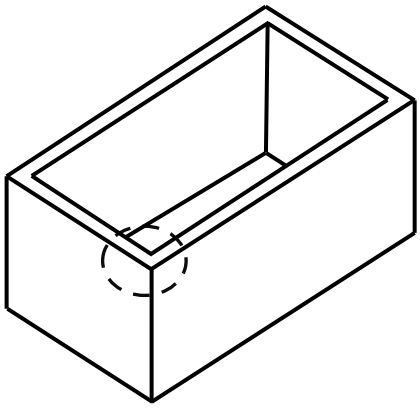
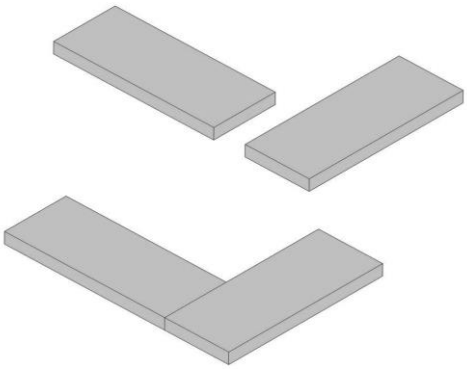
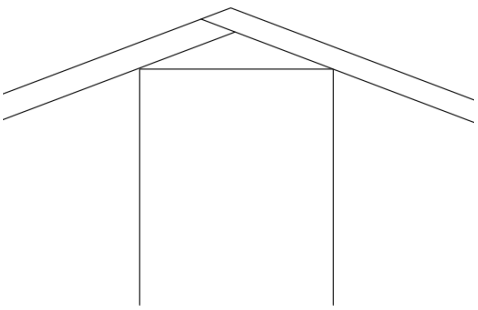
The joint requires the use of only one drill bit. Standard sizes are 6/8/10/12 mm in Diameter.

- The Diameter should be between ⅓ – ½ of the board thickness.
- Minimum Length should be 2 - 3 times the thickness of the boards.
- It is fast and efficient
- Provides guidance when gluing
- More glue surface for panel assembly

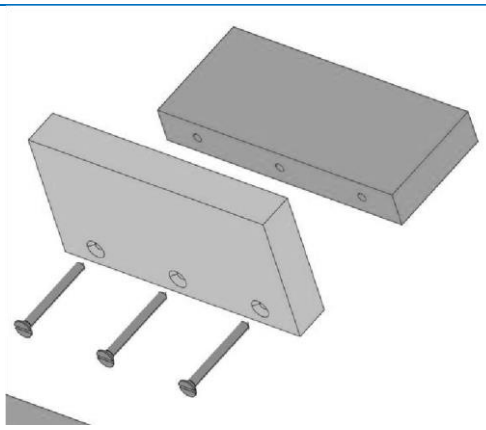
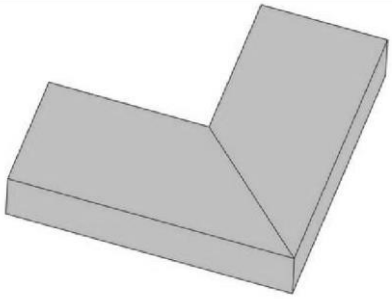
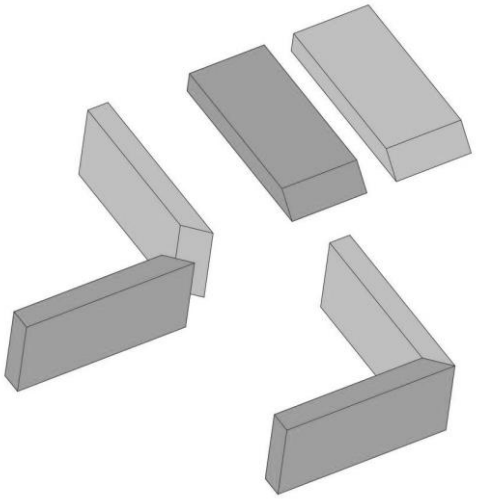


UNIT 3. LEARNING UNITY 1: WOOD WORKING JOINTS FOR SOLID WOOD: FRAME JOINTS

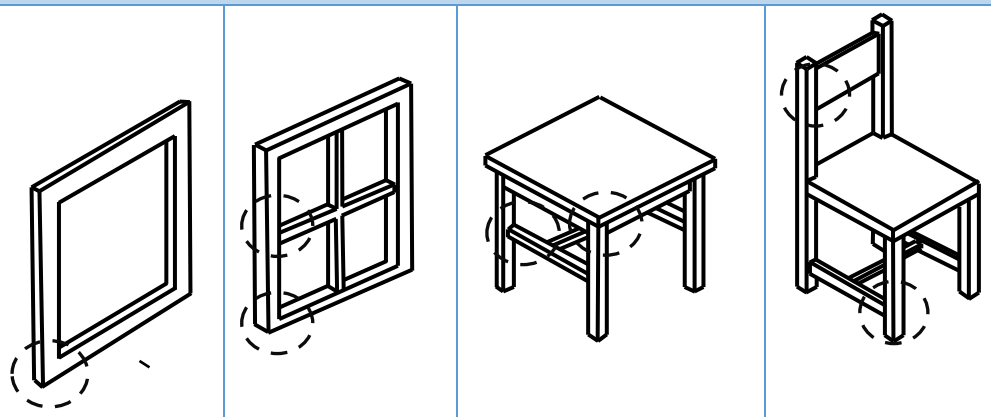
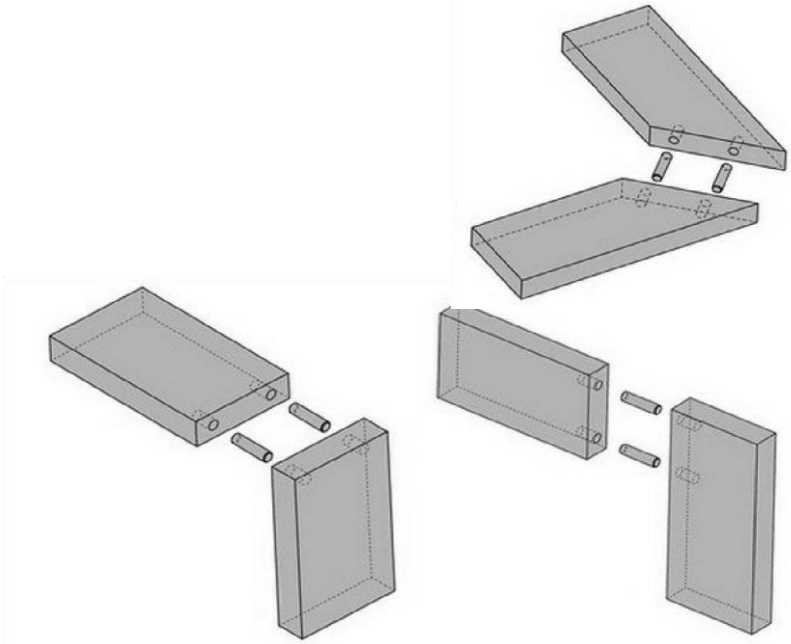
3.1. Butt Joints - Square-ended butt joint

Description:	Simple Corner Joint, useful for simple flat frames and simple box structures.	
Application:		
Illustration:	Square End Butt Joint 	Square End Butt Joint (reinforced) 

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	Good	Easy	Easy
Plywood	Good	Easy	Easy
Block board	Good	Easy	Easy
Chipboard	Good	Easy	Easy
MDF	Good	Easy	Easy

Reinforcing a butt joint For additional strength, drive nails at an angle into the wood. For stronger joints use wood screws. Make sure to pre-drill the screws and countersink the heads. If nails or screws are not an option gluing a corner block would reinforce the joint.	
The Mitred butt joint is very common for picture frames. The biggest advantage is, that the end grain is not visible. Cutting wood at 45 degrees produced a relatively large surface area of tangentially cut grain that glues quite good. For lightweight frames, just add glue for bigger loads use some additional biscuit joints, dowels or nails.	
The mitred butt joint also works well on wood-based panels. Just glue and fix the joint with adhesive tape packing tape During setting of the glue. Before you cut, always ensure that the mitre is exactly half the joint angle, or the joint will develop a gap. In addition, use well-seasoned timber or a gap may open up on the inside of the joint as the wood shrinks.	

3.2 Dowel Joints

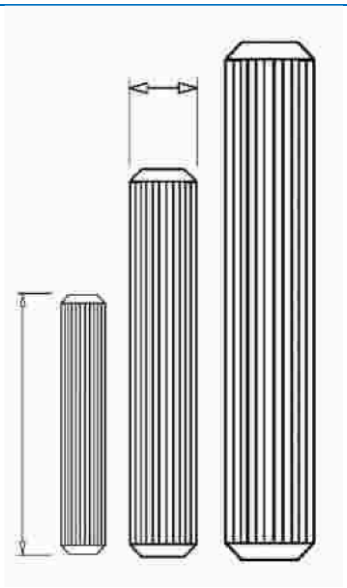
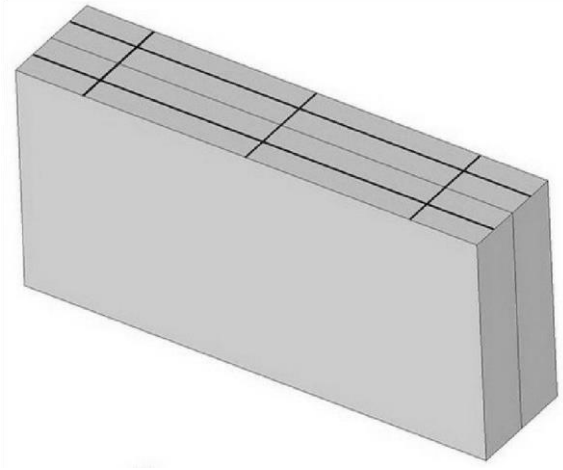
Description:	Simple Corner Joint, fast and durable, needs precise marking and drilling.
Application:	
Illustration:	

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	Good	Medium	Good
Plywood	Good	Medium	Good
Block board	Good	Medium	Good

Chipboard	**Good**	**Medium**	**Good**
MDF	**Good**	**Medium**	**Good**

<table>
<tr>
<td>

- The joint requires the use of only one drill bit. Standard sizes are 6/8/10/12 mm in Diameter.
- The Diameter should be between ½ - ⅔ of the board thickness.
- The length of the dowel should be 4 or 5 time the diameter of the dowel.
- Minimum length should be 2 - 3 times the thickness of the boards.
- It is fast and efficient.
- Provides guidance when gluing.
- More glue surface for panel assembly.

</td>
<td>  </td>
</tr>
<tr>
<td>The marking must be done very precise. Jigs and templates are useful to prepare accurate drillings.
Use drill bits with centre bits.</td>
<td>  </td>
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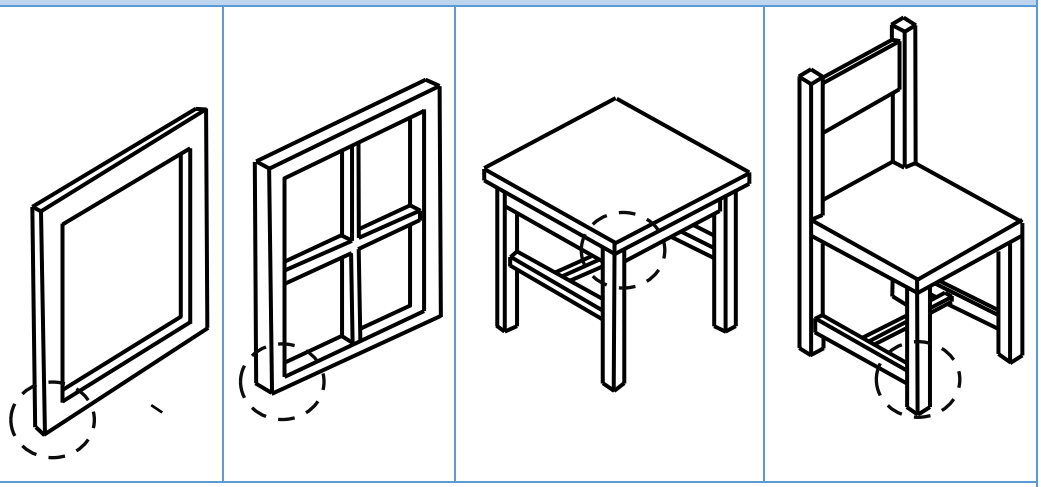
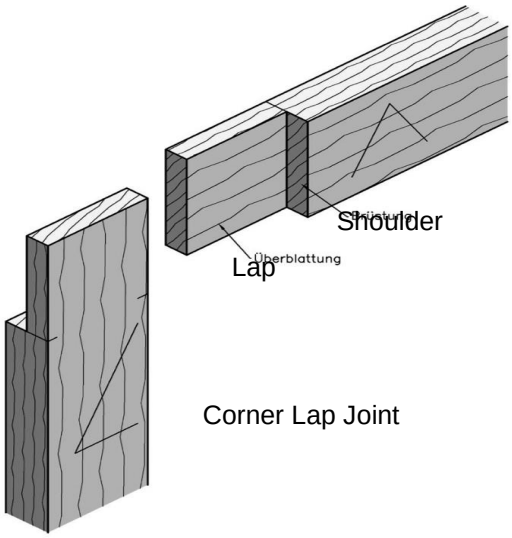
</table>

3.3 Corner Halving Joint - Overview

Description:	Simple Corner Joint, useful for simple corner und cross joints.
Application:	
Illustration:	 Corner Lap Joint

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**Medium**	**Easy**
Plywood	**/**	**/**	**/**
Block board	**/**	**/**	**/**
Chipboard	**/**	**/**	**/**
MDF	**/**	**/**	**/**

A Corner Halving Joint connects two pieces of wood mostly in frame constructions.

In its most basic form, this joint is both simple and strong.

As a Corner Halving Joint this joint uses the end grain from two pieces of wood at right angles to form an overlap.

This type of joint can be made by cutting the frame pieces, it could be created using chisels if working on small projects such as boxes or trays.

When properly made and glued together a Corner Halving Joint is fairly strong, but it depends on the quality of the gluing.

Advantages:

- These joints are fairly strong and stable joints that can be used in many projects.
- Easy to make, can be done with simple tools.
- The joint may be reinforced by pins or dowels.

Disadvantages:

- Strength depends on the quality of the gluing.

3.4 Mortise and Tenon

3.4.1 Overview

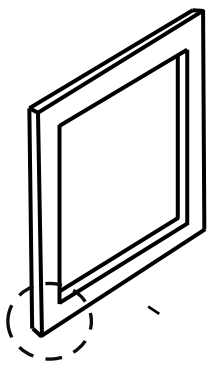
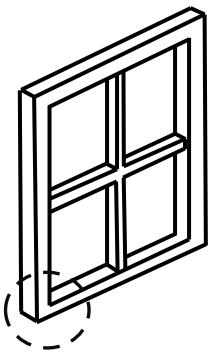
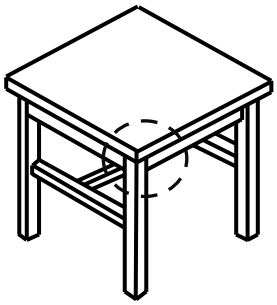
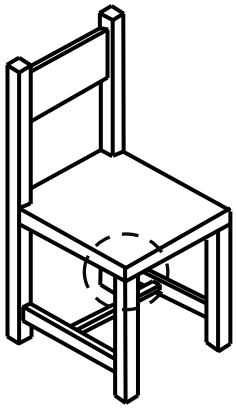
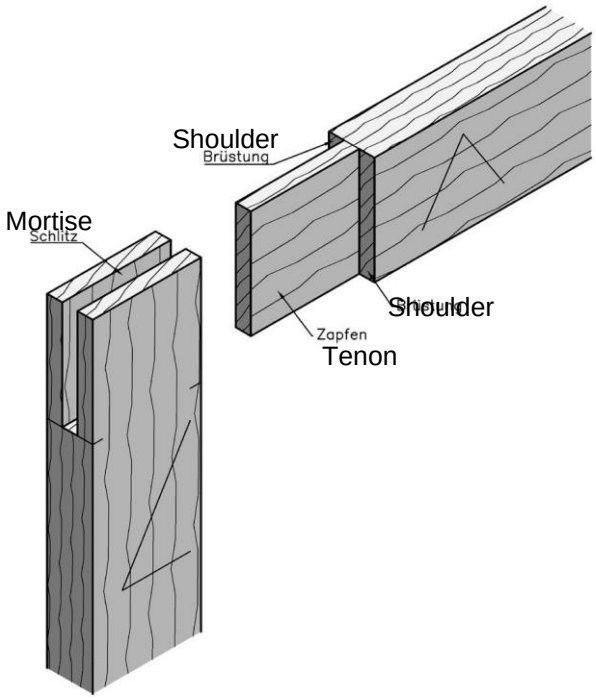
Description:	**A mortise and Tenon joint connects two pieces of wood mostly in frame constructions.**			
Application:				

Illustration:	

3.4.2 Introduction

A mortise and Tenon joint connects two pieces of wood mostly in frame constructions.

A mortise and Tenon joint is easy to make and durable.

This joint uses the end grain from two pieces of wood at right angles to form an interlocking pattern is known as the mortise and Tenon joint.

This type of joint can be made by hand and by machine.

When properly made and glued together, a mortise and Tenon joint is very strong and resists tension forces or bending.

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**Medium**	**Easy**
Plywood	**/**	**/**	**/**
Block board	**/**	**/**	**/**
Chipboard	**/**	**/**	**/**
MDF	**/**	**/**	**/**

There are many variations of this joint, but it always has two components:

- The mortise and
- the Tenon

The Tenon, formed on the end of a frame generally referred fits into a square or rectangular hole cut into the other frame piece. The Tenon is cut to fit the mortise hole exactly. It usually has shoulders that seat when the joint fully enters the mortise hole.

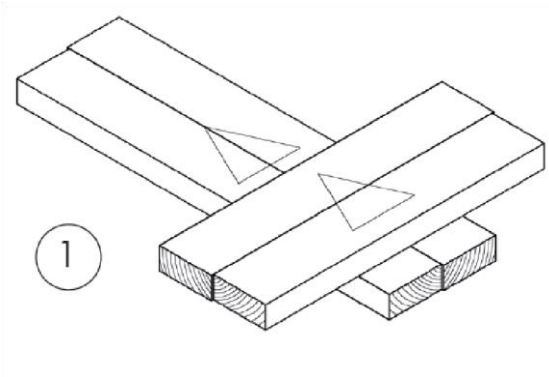
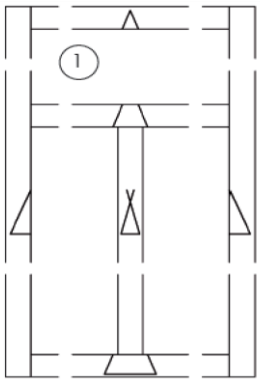
Advantages:

- Mortise and Tenon joints are strong and stable joints that can be used in many projects.
- They joint is glued or the parts are locked into place.
- The joint may be reinforced by pins, dowels, or wedged.

Disadvantages:

- Difficult to make it needs precise workmanship and a good fitting of the joints.
- Strength depends on the quality of the gluing.

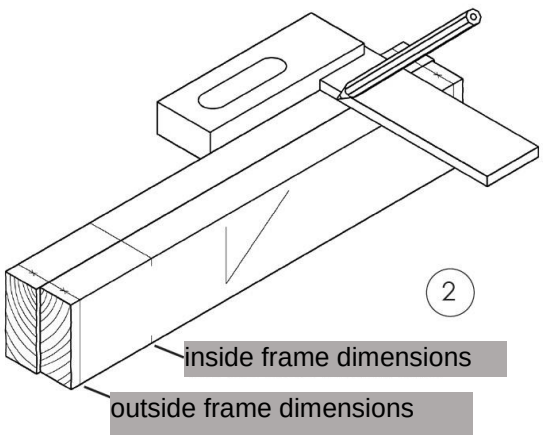
3.4.3 Step by Step Guideline

1) Marking out of the frame (Sample of a frame with 4 frame pieces)	**1) Marking out of the frame (Sample of a frame with 6 frame pieces)**
	

2) Marking the outer length (finished size) and the shoulder line.

You start with clamping all the same parts.

A marking of all the parts with the same lengths at the same time contributes to dimensional accuracy. First, the external dimension of the work piece gets marked. (1-2 mm extra length will help to keep the dimensions of the finished frame). Then the inner measurements are taken and transferred to all parts.

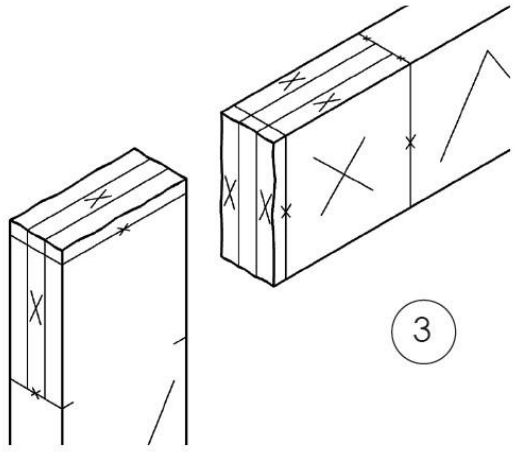


3) Taking the marking around the work piece with try square

The markings are extended around the frame pieces.

Lines on parts which are not sawn or chiselled out should be interrupted, or not drawn at all.

The Parts which are cut away are marked with an **X** to avoid mistakes.

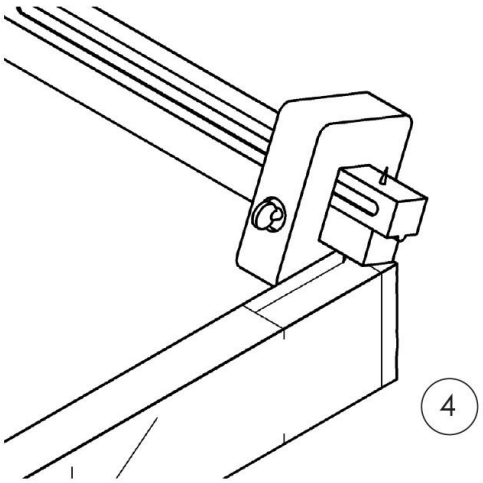


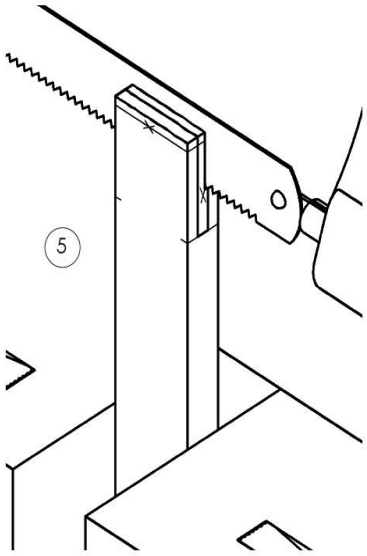
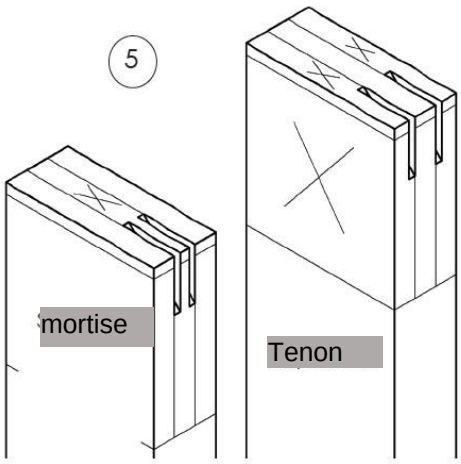
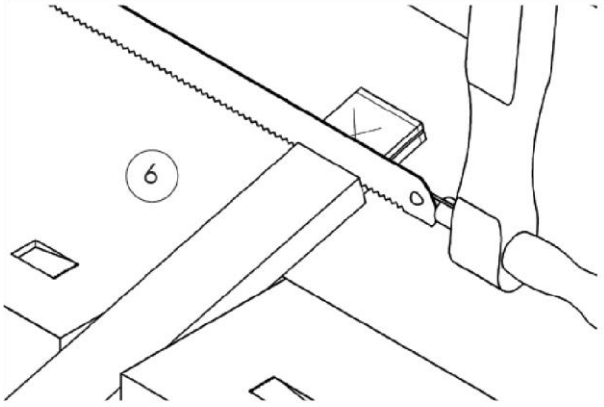
4) Marking of the mortise and Tenon

The mortise and Tenon are marked on the end and the sides of the work piece with a marking gauge

(Tenon thickness is usually 1/3 of the wood thickness).

With small crosses you should mark the waste pieces, to ensure that the saw cut is on the right side of the marking.

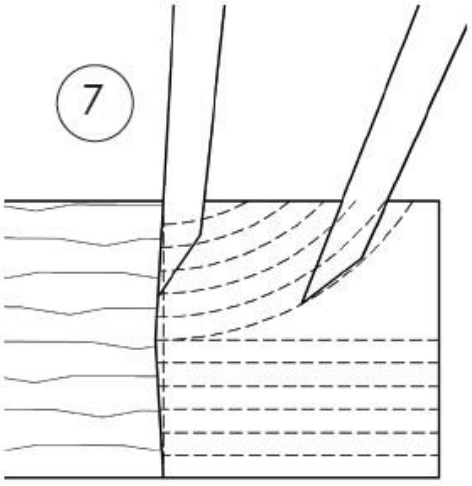


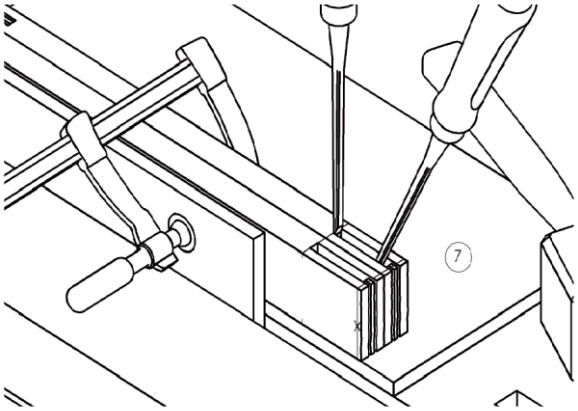
5) Cutting of the mortise and Tenon Fix the work piece in a vice, saw both sides on the mortise and both sides of the Tenon. Make sure that you are keeping on the waste side of the marking and do not cut deeper than the shoulder line.	
6) Cutting of the mortise and Tenon Detailed view on the marking and cutting.	
7) Sawing of the shoulders Remove the waste by cutting down the shoulder on both sides. Make sure not to cut into the Tenon.	

8) Preparing the mortise

Fix the frame pieces on a work bench During the first mortising process form the first side a piece of waste should remain at the end of the wood. This prevents the waste from springing or breaking off during the mortising work on the second side.

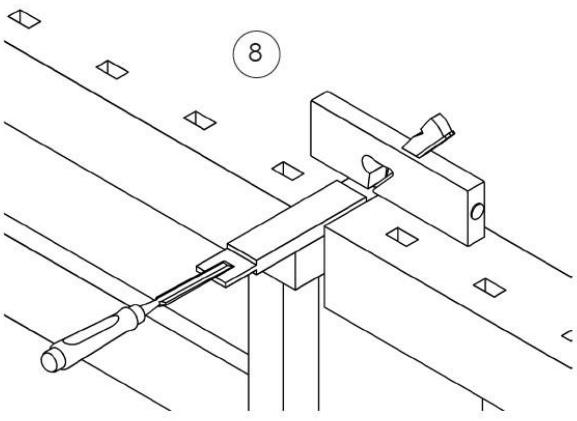
Take out a bit of material from the ground of the slot to avoid some waste left behind and prevent a proper fitting during the assembly.

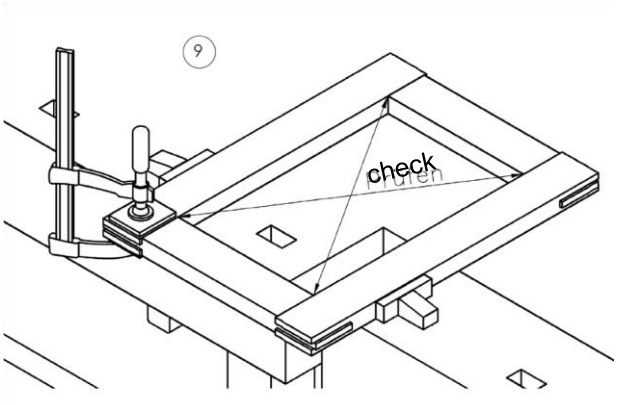




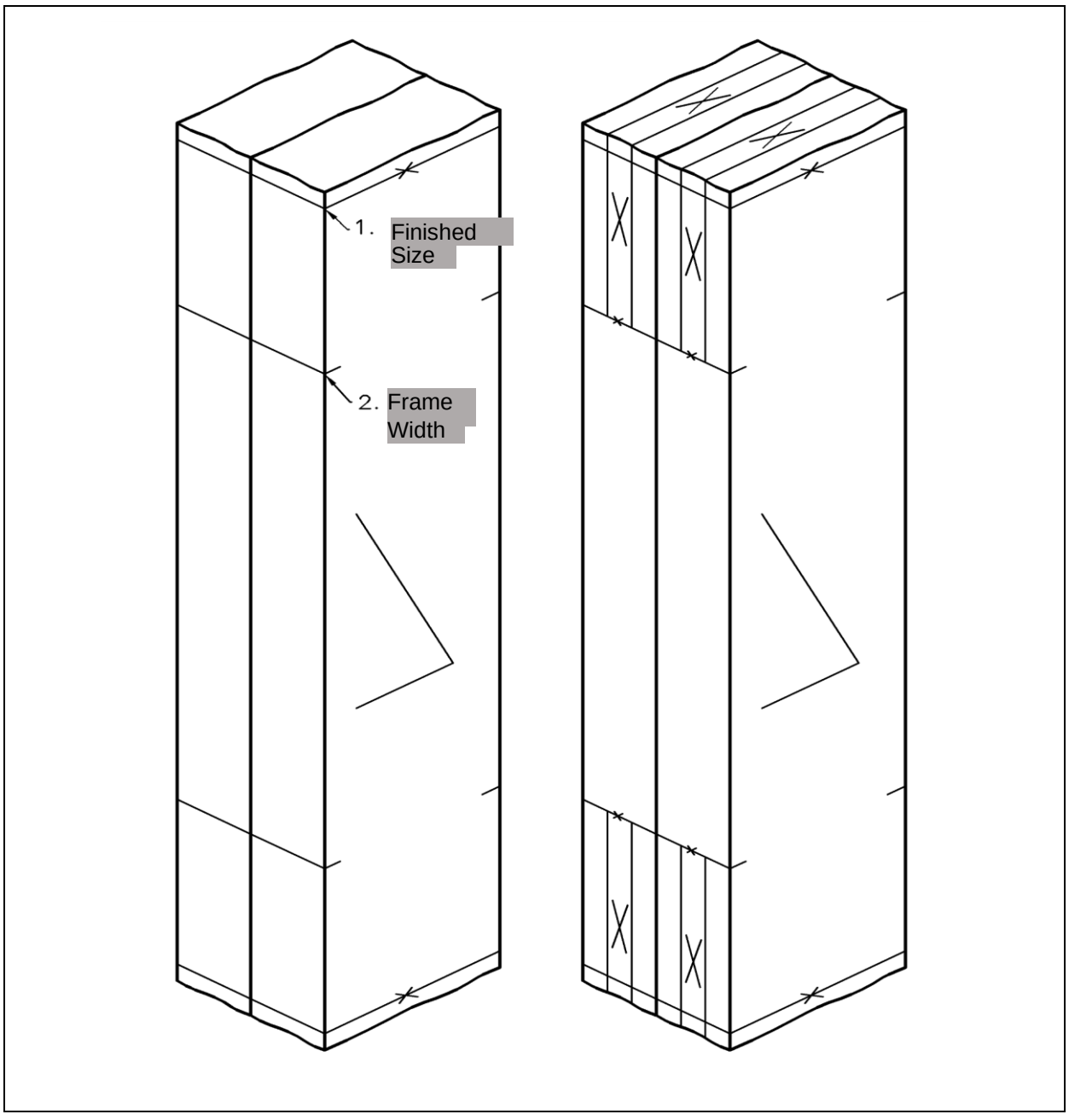
9) Final touch

If necessary, make final touches with a chisel to ensure that the corners are clean and rectangular.

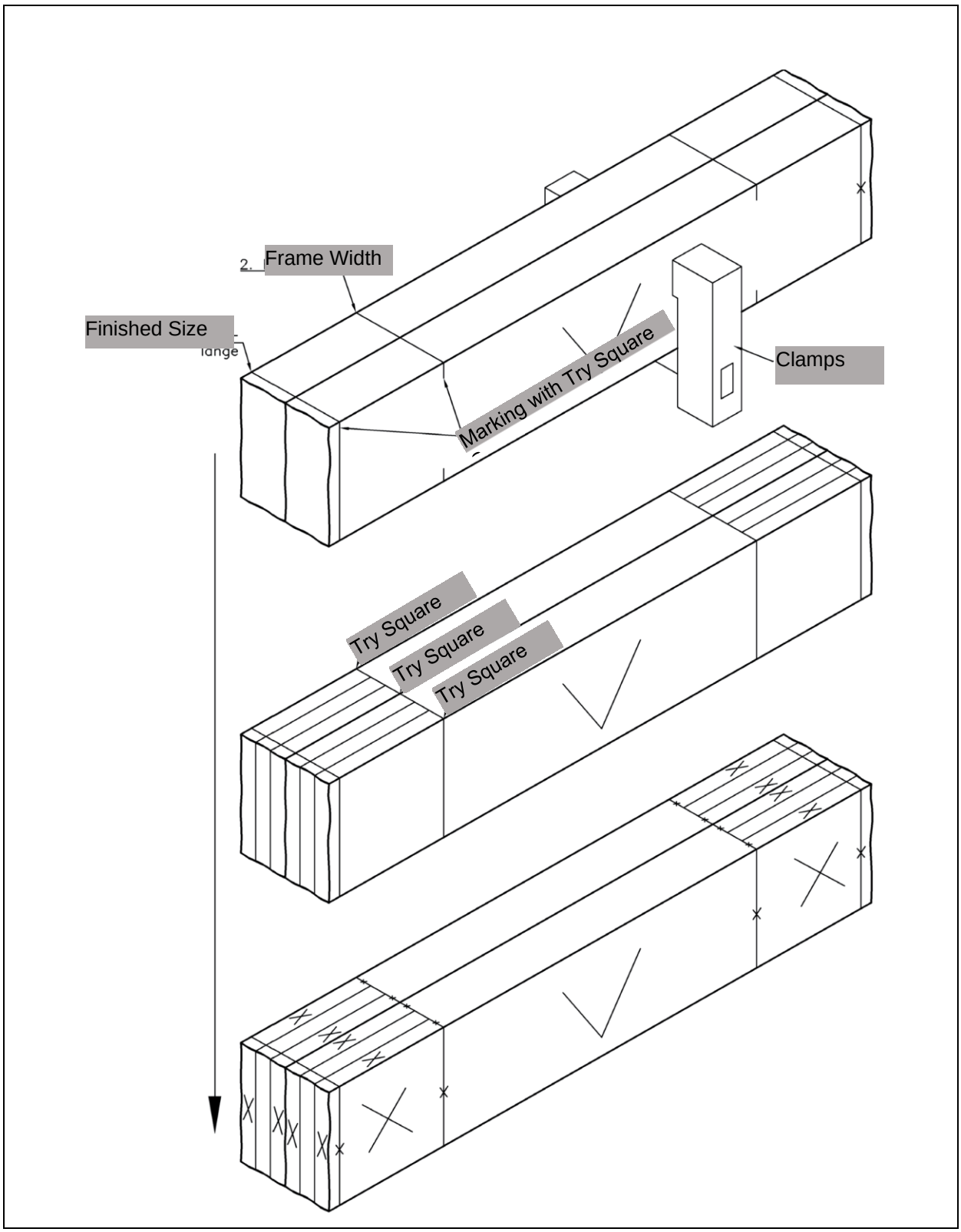


10) Dry fit and gluing Make a final check. Apply the glue. Set some clamps at the corners to apply pressure. Check if the frame is rectangular by taking the diagonal dimensions. Store the frame even and flat, check if it is twisted.	

3.4.4 Marking Out 1

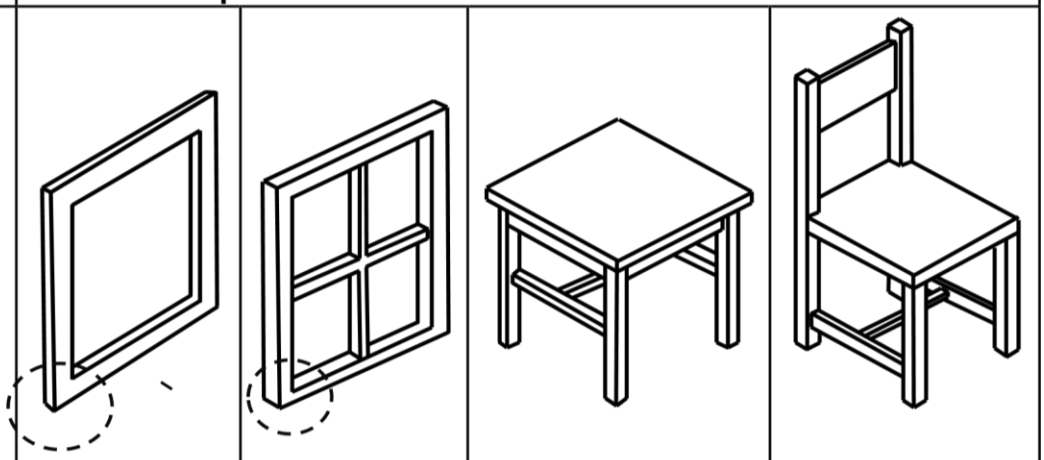
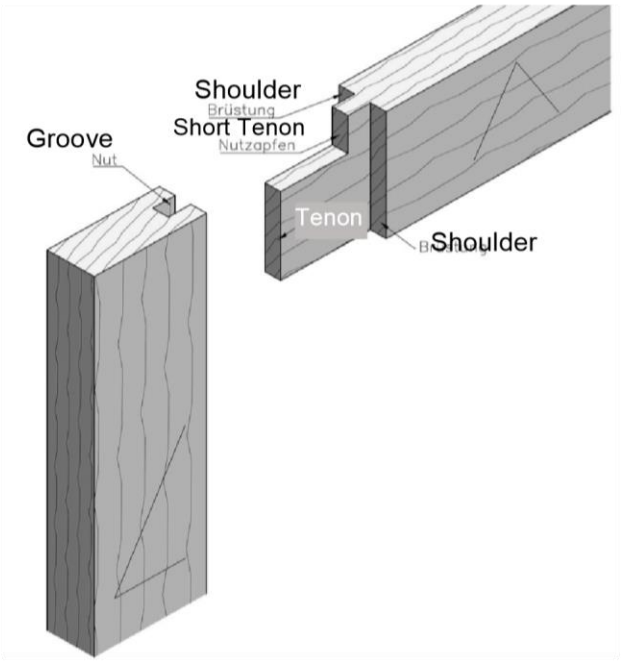


3.4.5 Marking Out 2



3.5 Haunched Mortise and Tenon Joint

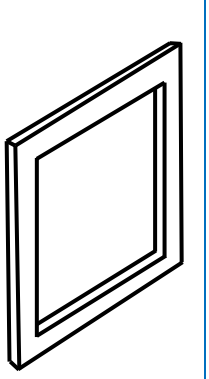
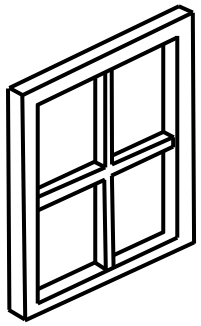
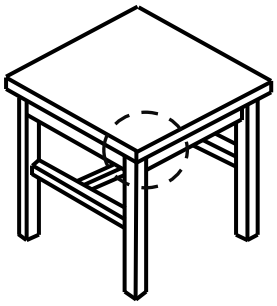
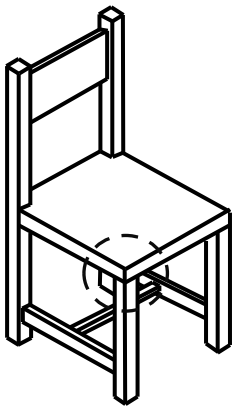
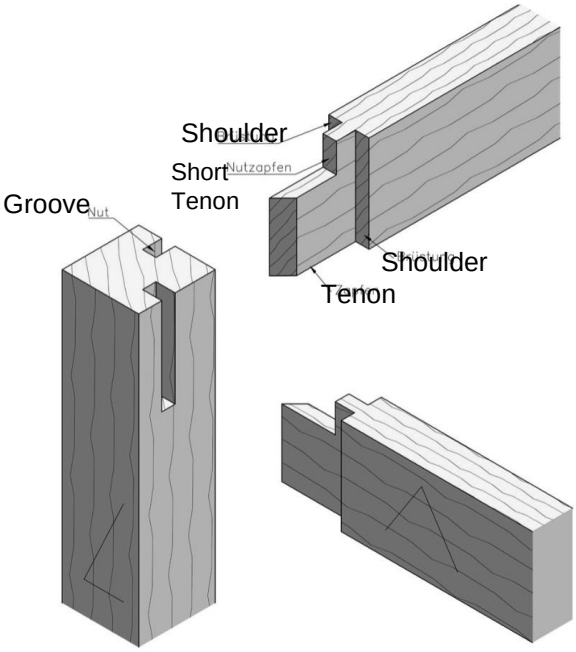
3.5.1 Frame Joint-Overview

Description:	**A haunched mortise and tenon joint connects two pieces of wood mostly in frame constructions. It is particularly suitable for wider frame pieces in door constructions**
Application:	
Illustration:	

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**Medium**	**Medium**
Plywood	**/**	**/**	**/**
Block board	**/**	**/**	**/**

Chipboard	**/**	**/**	**/**
MDF	**/**	**/**	**/**

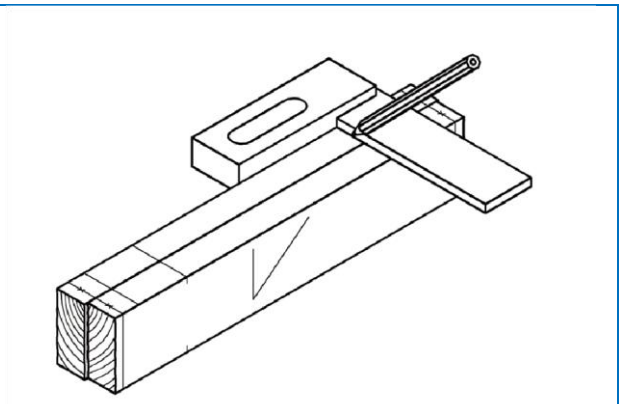
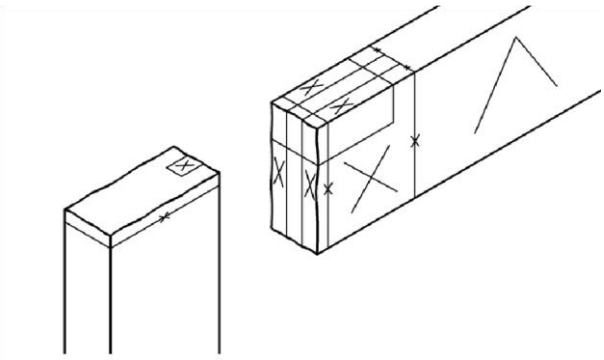
3.5.2 Corner Joint - Overview

Description:	**Haunched Mortise and Tenon Joint, Corner Joint connects two frame pieces with a chair or table le.g... It is particularly suitable for Chair or table constructions**
Application:	   
Illustration:	

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**Medium**	**Medium**

Plywood	/	/	/
Block board	/	/	/
Chipboard	/	/	/
MDF	/	/	/

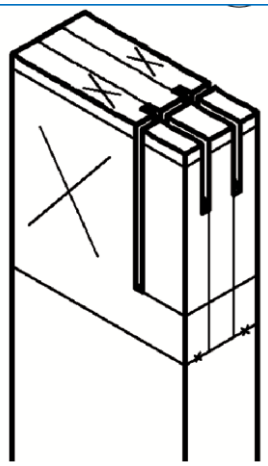
3.5.3 Step-by-Step Guideline

1) Marking out of the frame (Sample of a frame with 2 frame pieces) Marking with a try square.	
2) Marking of the haunch Mark the length of the haunch across and down the sides of the frame.	

3) Marking of the haunch

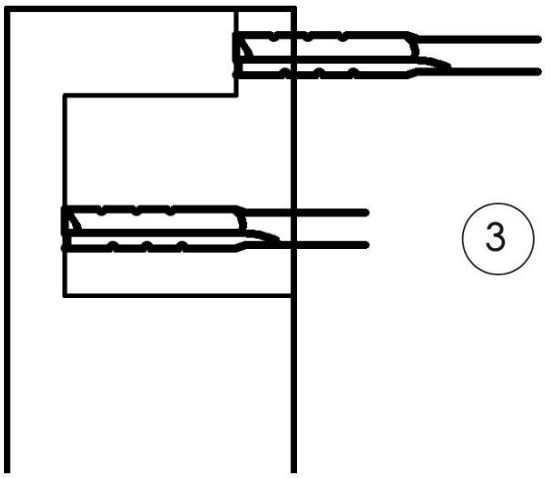
The markings are extended around the frame pieces.

Mark the waste with a X.

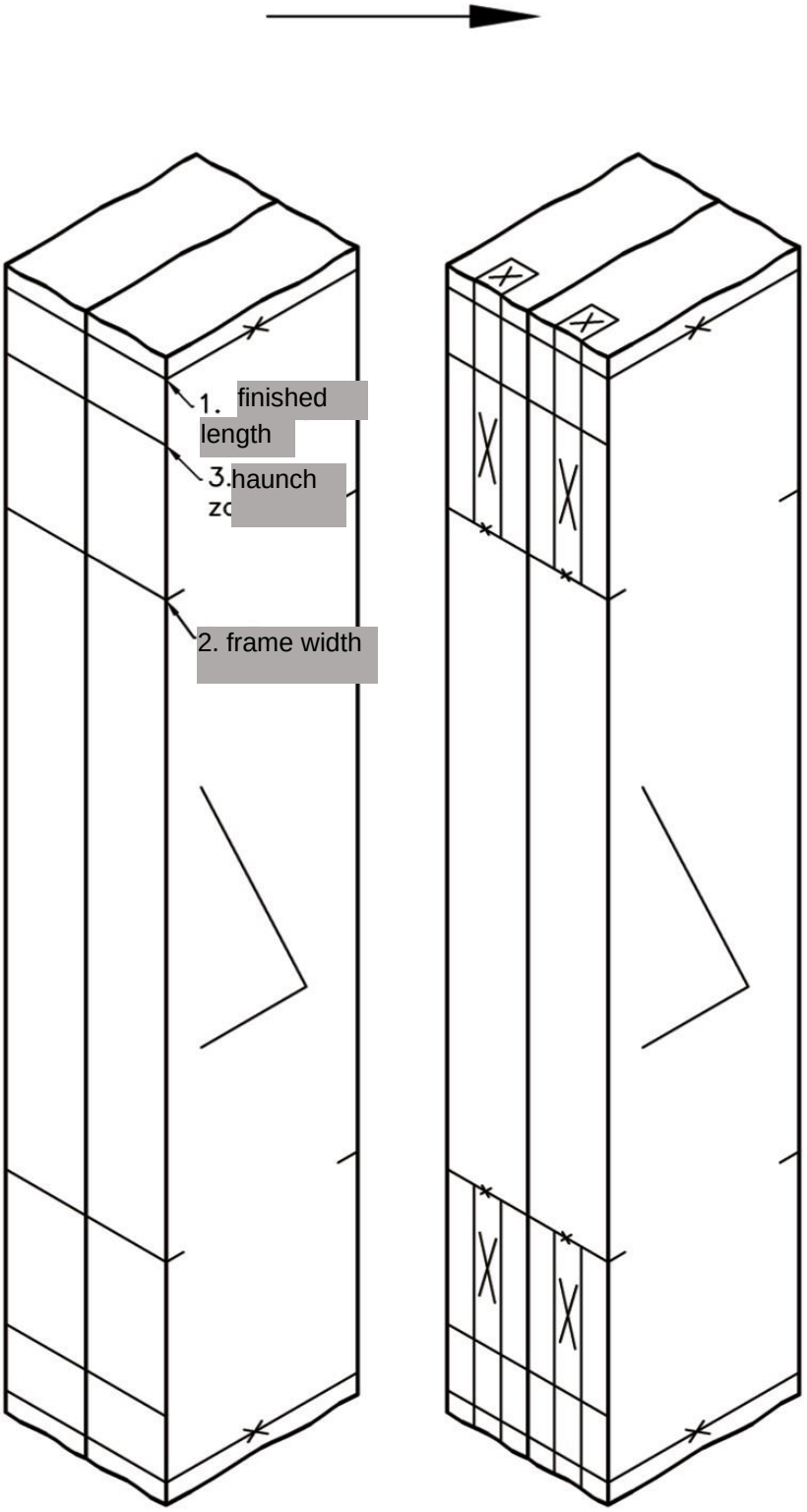


4) Preparing of the mortise/groove

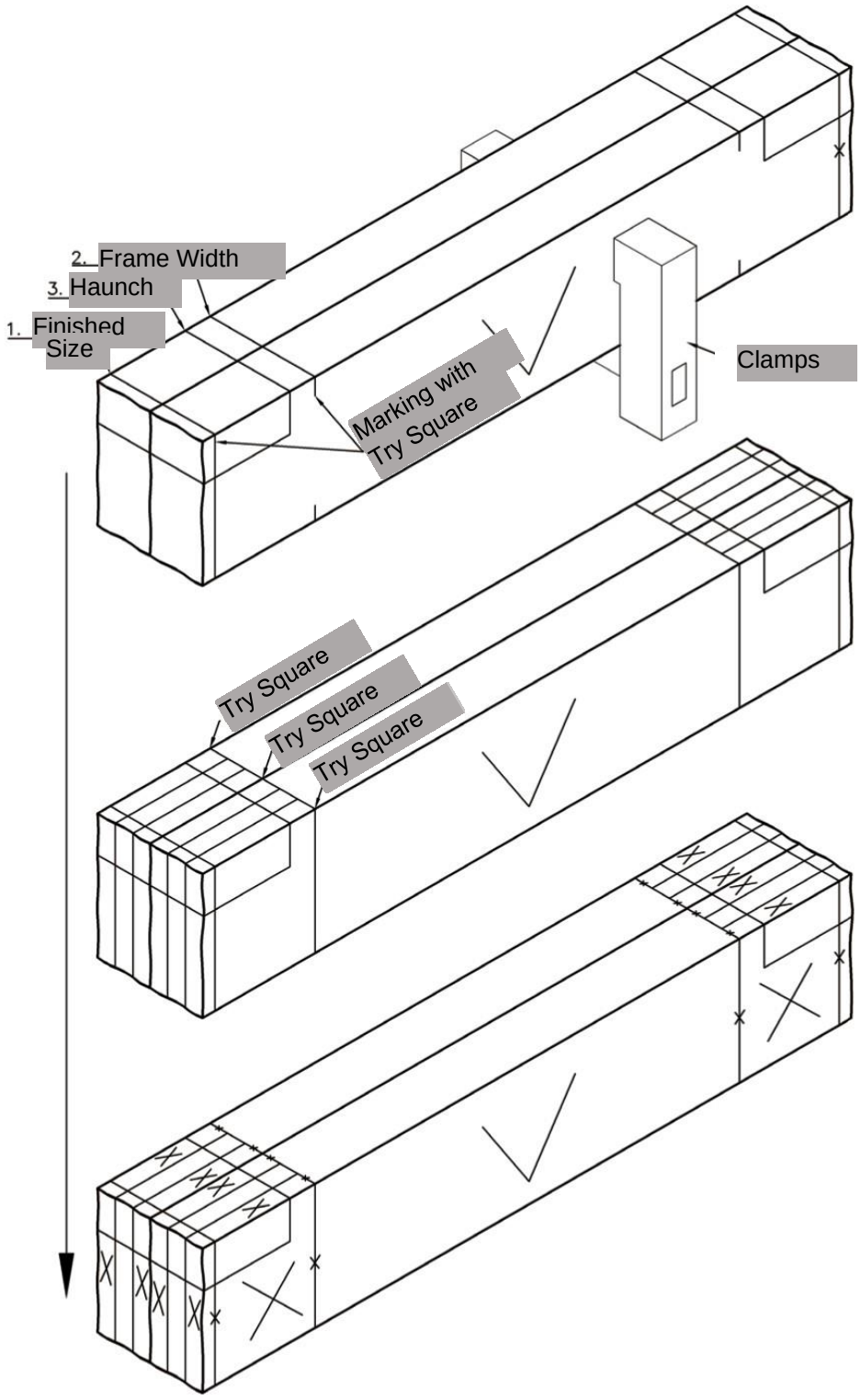
The groove and the mortise could be prepared with a drilling machine or a slot mortise machine.



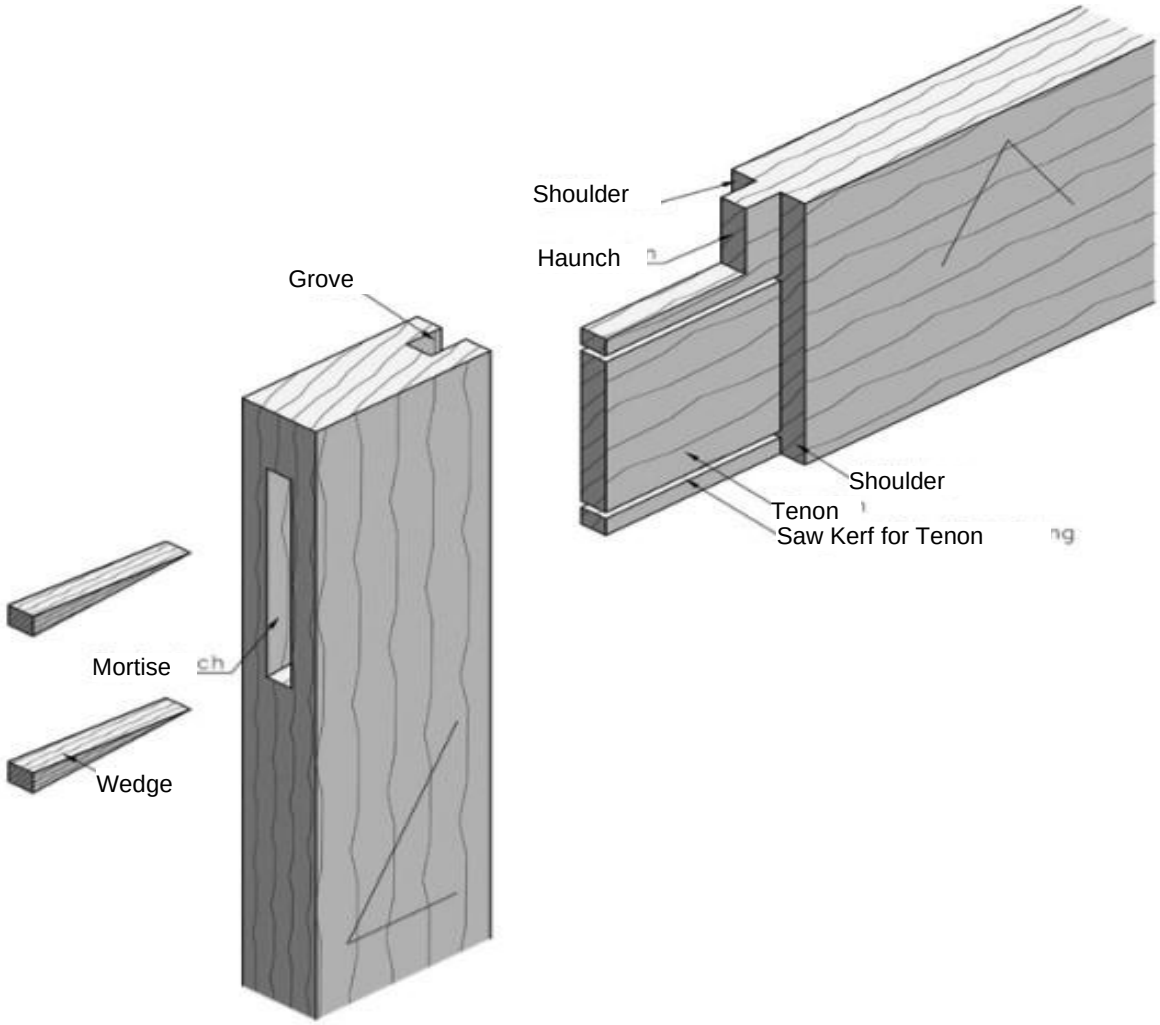
3.5.4 Marking Out 1



3.5.5 Marking Out 2

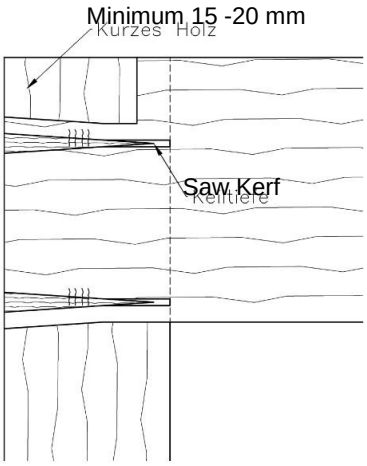


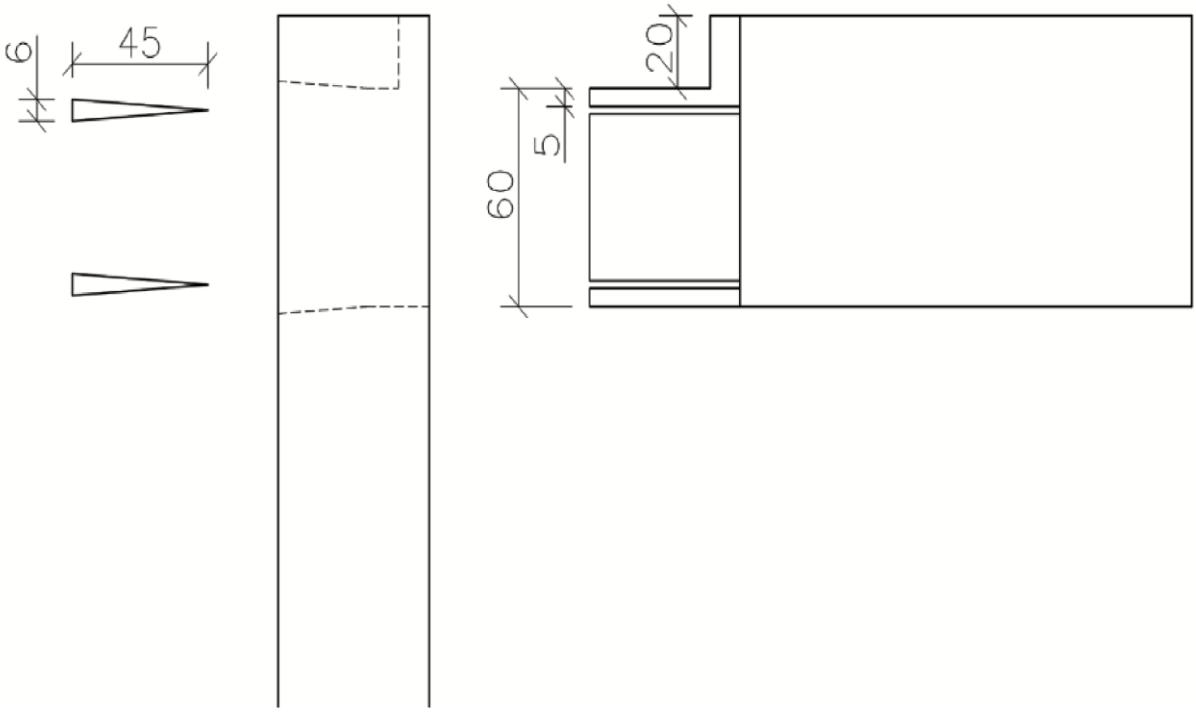
3.3.6 Wedged Mortise and Tenon Joint – Step-by-Step Guideline



In some cases, the joint can be designed as a through mortise and Tenon joint. The joint can be reinforced by a wedged joint through the upright frame.

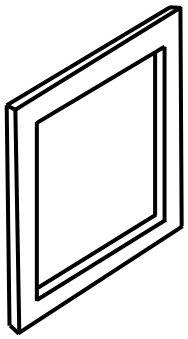
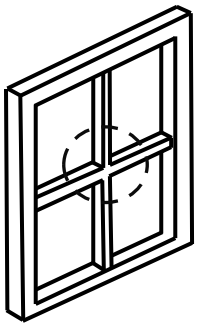
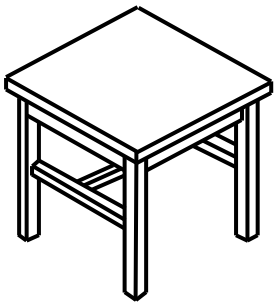
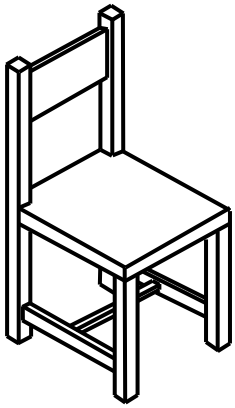
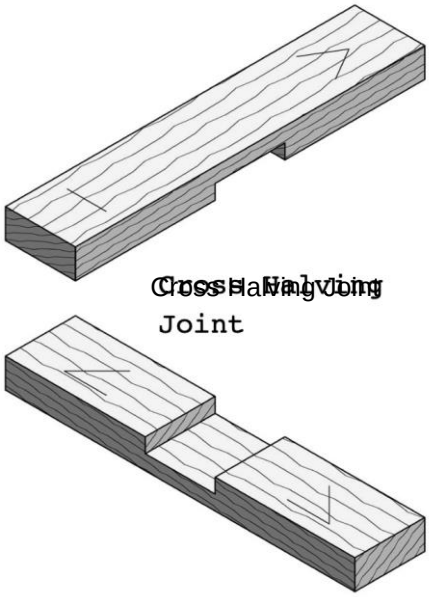
This will significantly increase the stability of the joint, as the Tenon will develop some additional pressure in the slot along the grain.





3.6 Cross Halving Joint

3.6.1 Overview

Description:	**Simple Corner Joint, useful for simple corner und cross joints**			
Application:				
Illustration:				

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**Medium**	**Easy**
Plywood	**/**	**/**	**/**
Block board	**/**	**/**	**/**
Chipboard	**/**	**/**	**/**

MDF	**/**	**/**	**/**

3.6.2 Introduction

A Cross Halving Joint and a Corner Halving Joint connects two pieces of wood mostly in frame constructions.

In its most basic form, this joint is both simple and strong.

As a Corner Halving Joint this joint uses the end grain from two pieces of wood at right angles to form an overlap.

This type of joint can be made by cutting the frame pieces, it could be created using chisels if working on small projects such as boxes or trays.

When properly made and glued together a Cross Halving Joint, Corner Halving Joint are fairly strong, but it depends on the quality of the gluing.

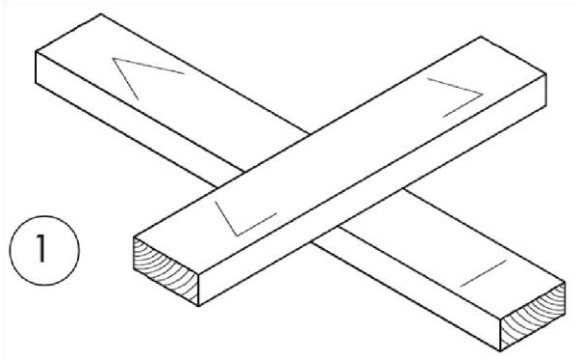
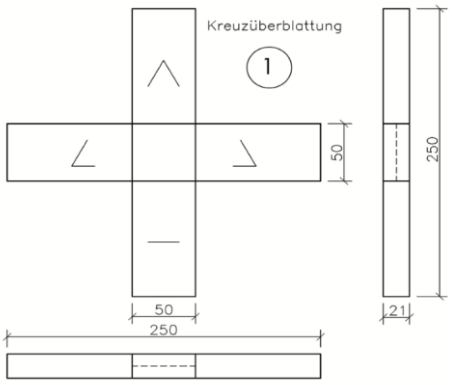
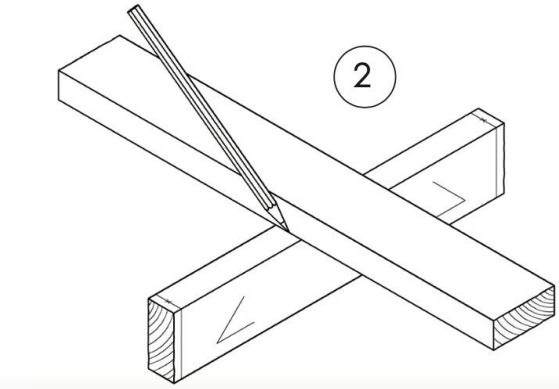
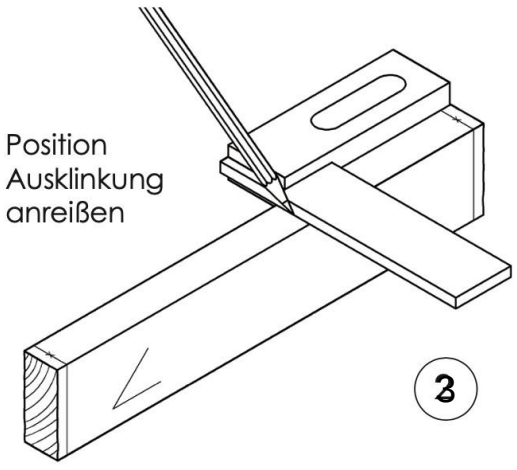
Advantages:

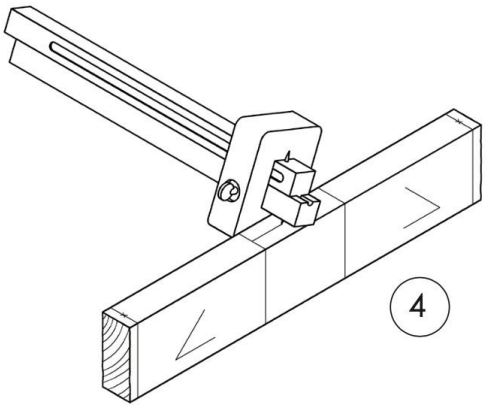
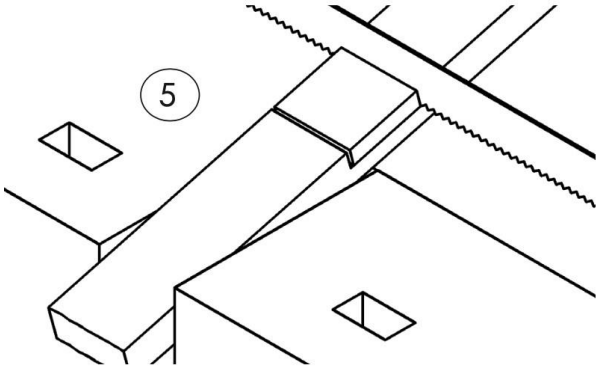
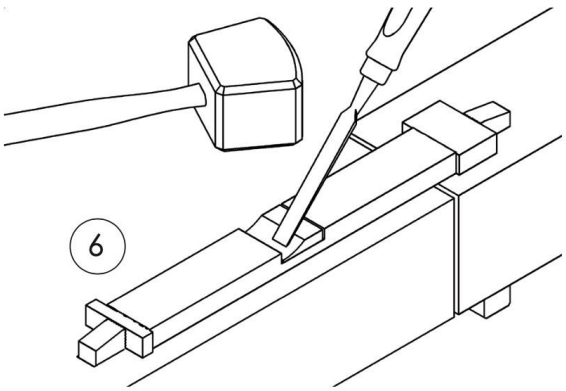
- These joints are fairly strong and stable joints that can be used in many projects.
- Easy to make, can be done with simple tools.
- The joint may be reinforced by pins or dowels.

Disadvantages:

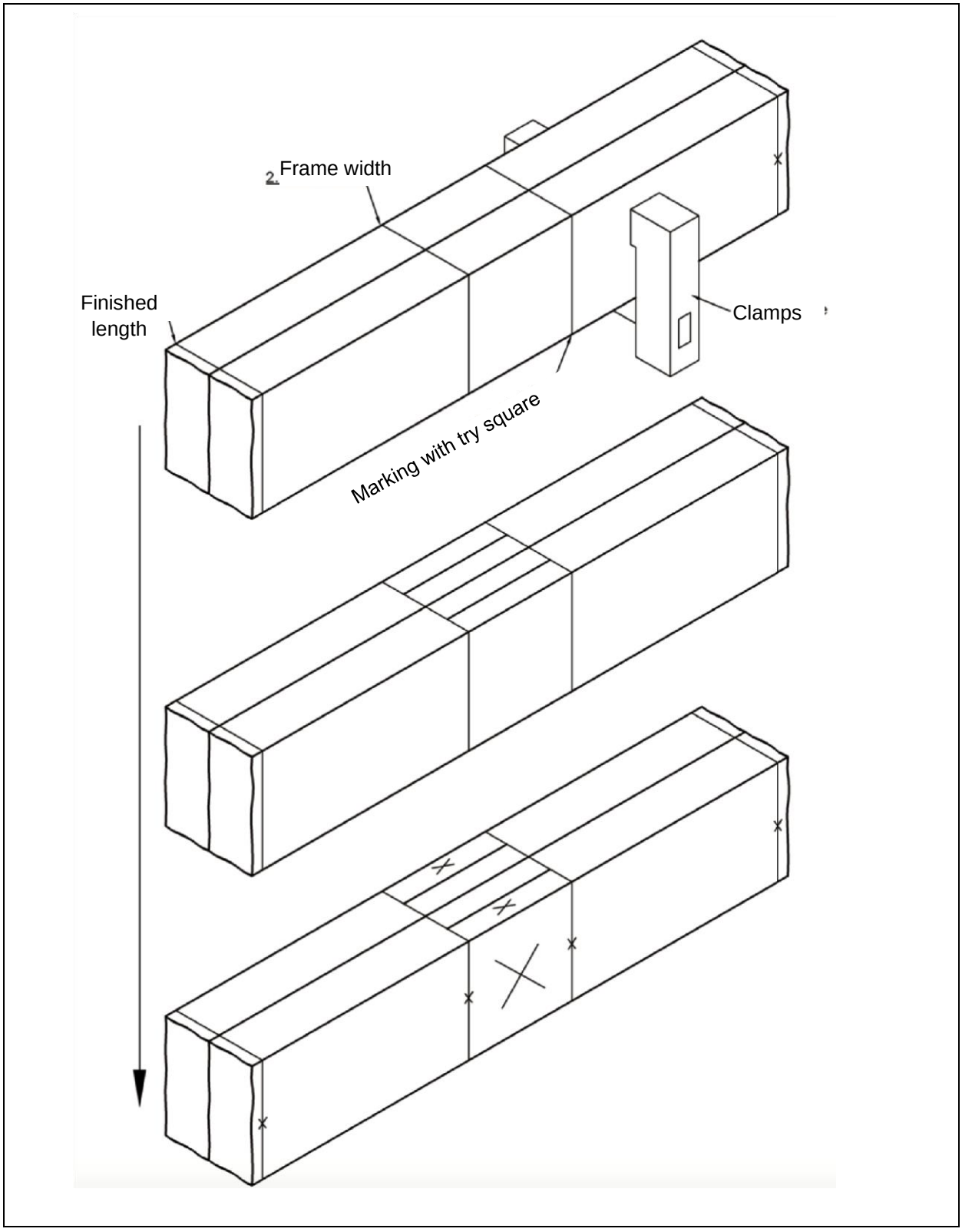
- Strength depends on the quality of the gluing.

3.6.3 Corner Halving Joint – Step by Step Guideline

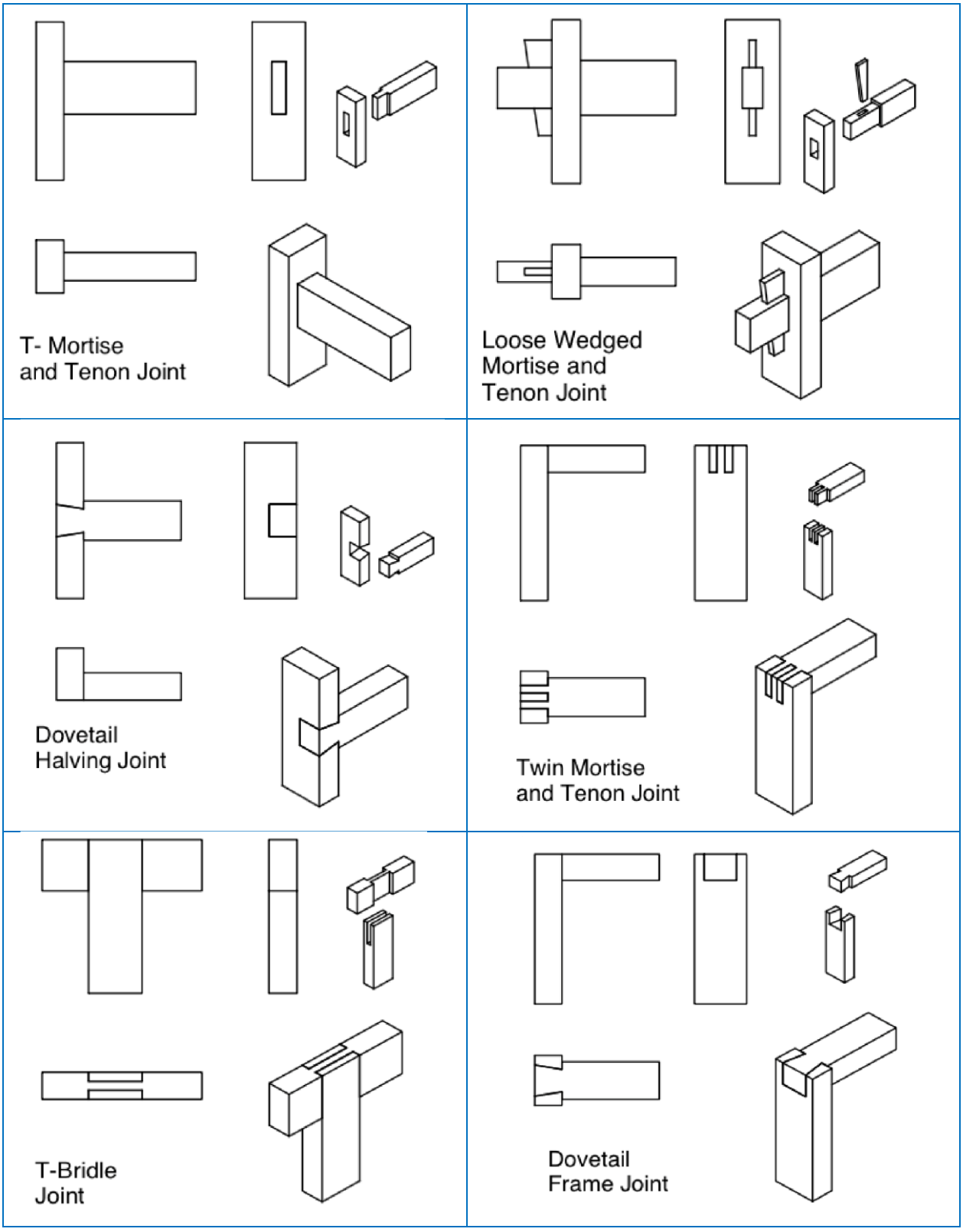
1) Marking out of the frame (Sample of a frame with 2 frame pieces) 	**1) Marking out of the frame (Sample of a frame with 2 frame pieces)** 
2) Marking the first shoulder You start with marking all the same parts. A marking of all the parts with the same lengths at the same time contributes to dimensional accuracy. First is the marking of the lap shoulders on one side.	
3) Taking the marking around the work piece with a square The markings are extended around the frame pieces. Lines on parts which are not sawn or chiselled out should be interrupted, or not drawn at all. The parts which are cut away are marked with an **X** to avoid mistakes.	

4) Marking of the depth of the joint The **depth of the joint** is marked with a marking gauge on both sides (usually 1/2 of the wood thickness). With small crosses you should mark the waste pieces, to ensure that the saw cut is on the right side of the marking.	
5) Cutting the joint Saw halfway through both pieces on the waste side of each shoulder line. Alternative: Use a circular saw and prepare several saw kerfs across the frame	
6) Chopping out the waste on both frame pieces Prepare the bottom of the joint flat with a chisel.	

3.6.4 Marking Out



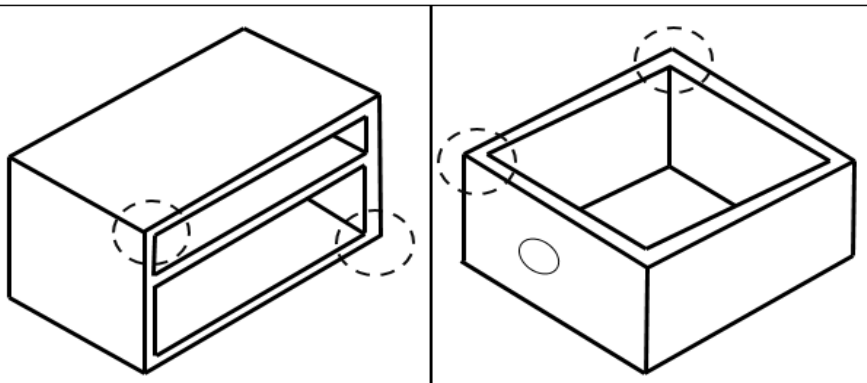
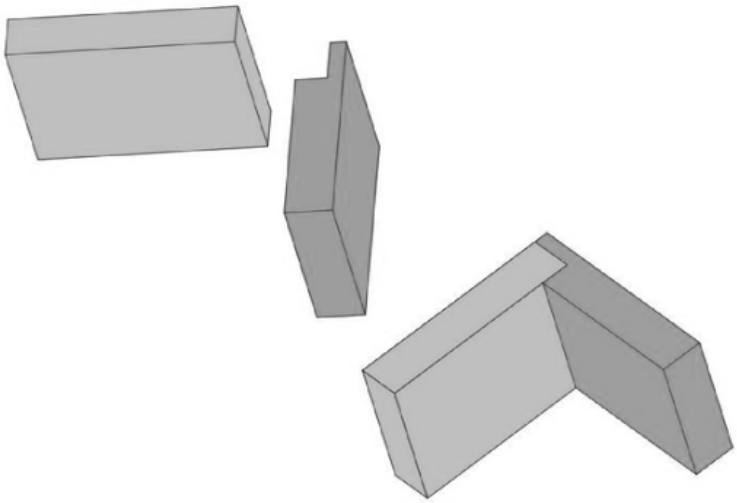
3.6.5 Alternative frame joints



UNIT 4. WOOD WORKING JOINTS FOR SOLID WOOD: CARCASS JOINTS

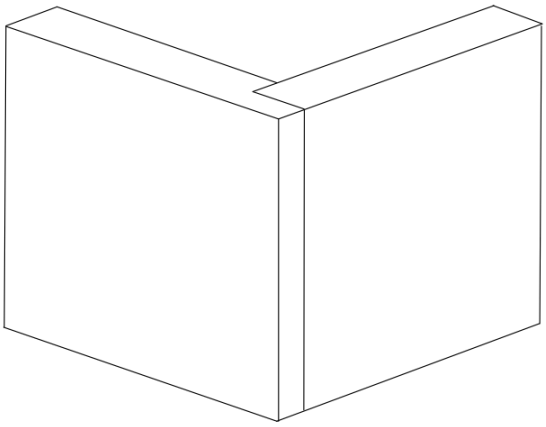
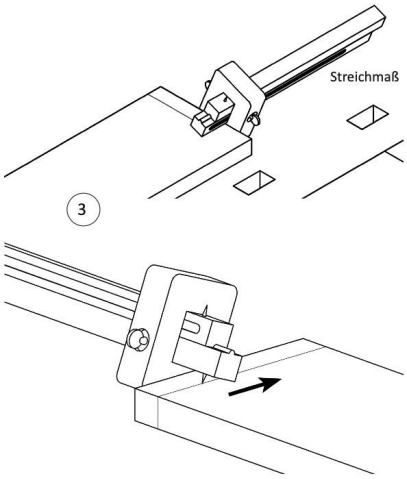
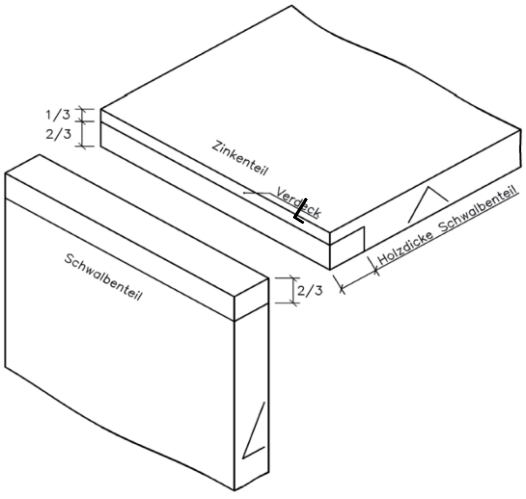
4.1 Lap joint

4.1.1 Overview

Description:	**A basic lap joint is stronger than a butt joint. It is an improvement in appearance since most of end grain is concealed. As a result, it is sometimes used as a relatively simple way of connecting a drawer front or the sides of a cabinet.**
Application:	
Illustration:	

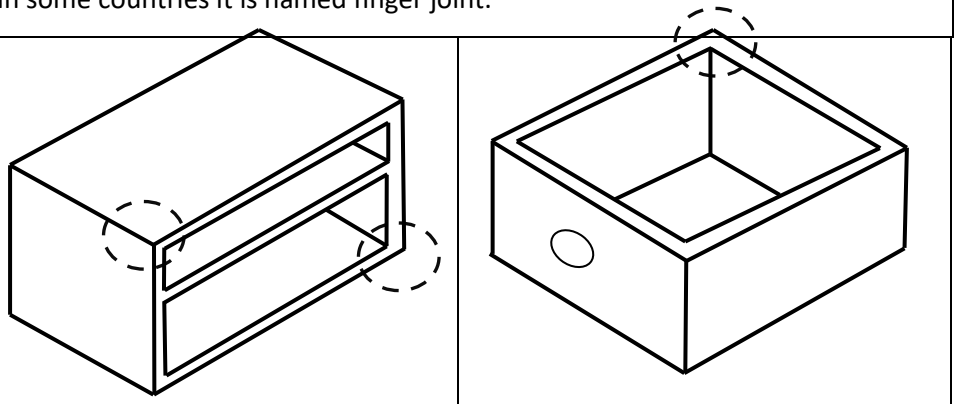
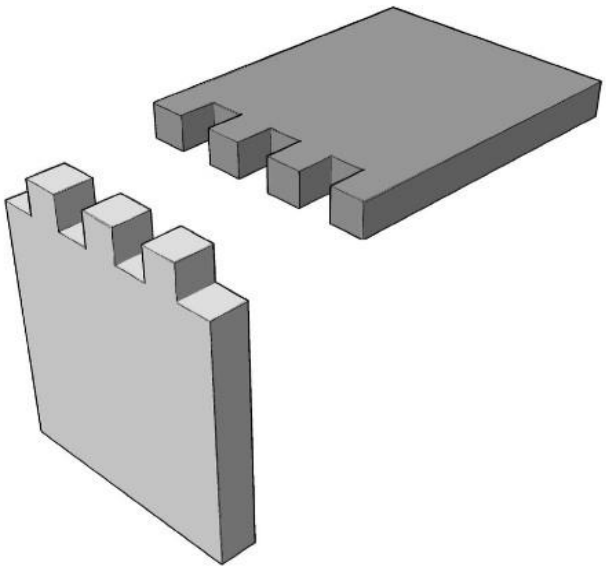
Material	Suitability	Hand Tool	Machine Tools
Solid Wood	Good	Medium	Easy
Plywood	Good	Medium	Easy
Block board	/	/	/
Chipboard	/	/	/
MDF	/	/	/

4.1.2 Lap Joint-Step by Step Guideline

1) Marking out the rabbet Cut and plane both members square. Adjust a marking gauge to about ¼ or ⅓ of the thickness of the rabbet member and scribe a line across the end grain, working from the face side. Continue the line on both edges, down to the level of the shoulder.	
2) Marking the shoulder Set a marking gauge to match the thickness of the side member and scribe a shoulder line parallel to end grain on the back of the rabbet member. Continue the shoulder line across both edges to meet the lines already scribed.	
3) Marking the shoulder Set a marking gauge to match the thickness of the side member, and scribe a shoulder line parallel to end grain on the back of the rabbet member. Continue the shoulder line across both edges to meet the lines already scribed.	

4.2 Box Joint (Finger Joint)

4.2.1 Overview

Description:	A box joint is a woodworking joint made by cutting a set of interlocking profiles in two pieces of wood, which are joined (usually) at right angles, usually glued. The glued box joint has a high glued surface area resulting in a strong bond. In some countries it is named finger joint.
Application:	
Illustration:	

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**Medium**	**Easy**
Plywood	**Good**	**Medium**	**Easy**
Block board	**/**	**/**	**/**
Chipboard	**/**	**/**	**/**
MDF	**/**	**/**	**/**

4.2.2 Box Joints – Introduction

Box joints are used for corners of boxes or box-like constructions.

The joint does not have the same interlocking properties as a dovetail joint, but is much simpler to make, and can be mass-produced with a simple machine setup (table saw or spindle moulder).

Advantages:

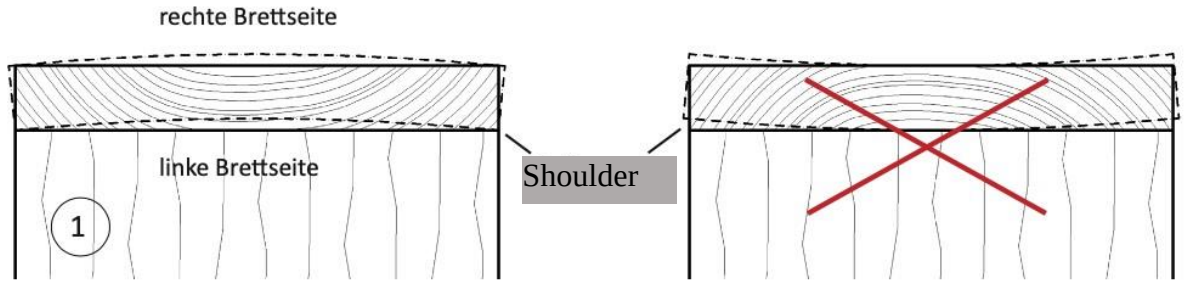
- Simple to make with hand tools or with table saw or/and spindle moulder.
- Big glue area gives strong bonding.

Disadvantages:

- Needs precise fitting.
- Does not interlock like a dovetail joint.

4.2.3 Box Joint – Step by Step Guideline

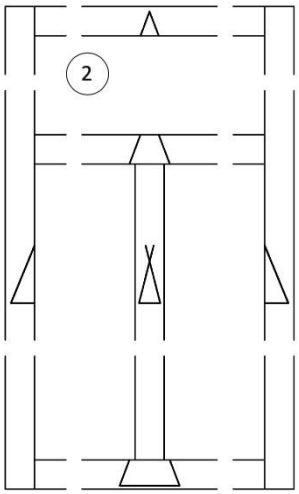
1) Arrange the parts according to the annual rings to make sure that the shoulders are not developing a gap after drying.



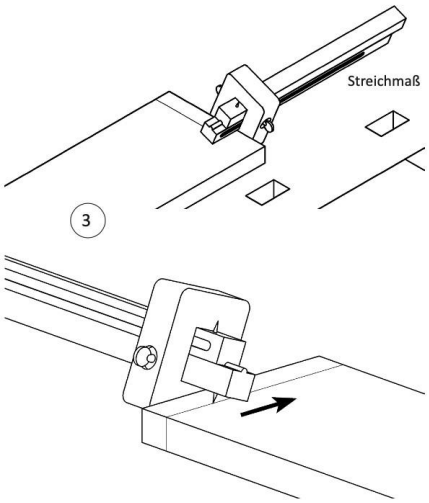
2) Get the parts organized and marked with the triangle system.

Keeping project parts organized and in proper relation to one another.

Once you have dressed your work pieces to thickness, width, and length, orient them and mark the faces with sections of triangles. This quickly identifies the face, top, bottom, left and right sides of a project.



3) The wood thickness at all board ends is determined with the marking gauge moved parallel to the end grain. Lines will only be applied where it will be sawn and chiselled because it's difficult to remove the marking later. Note: The marking gauge should always be drawn towards your body; it provides much better control.

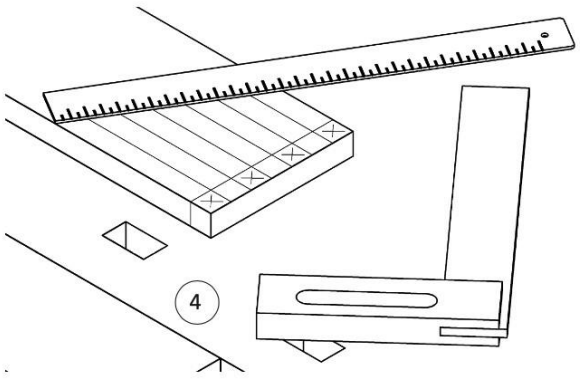


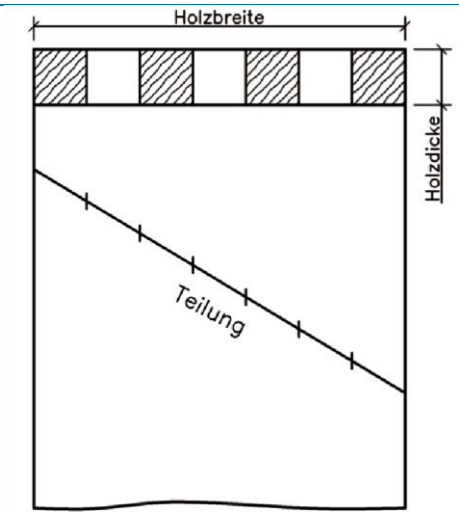
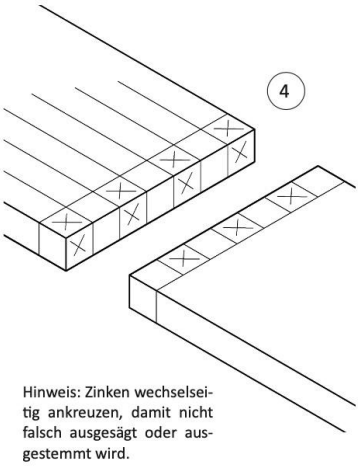
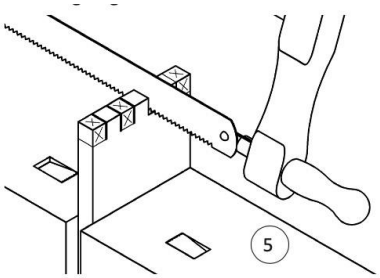
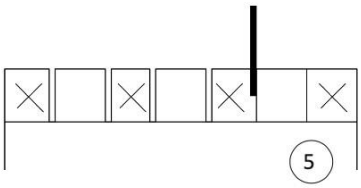
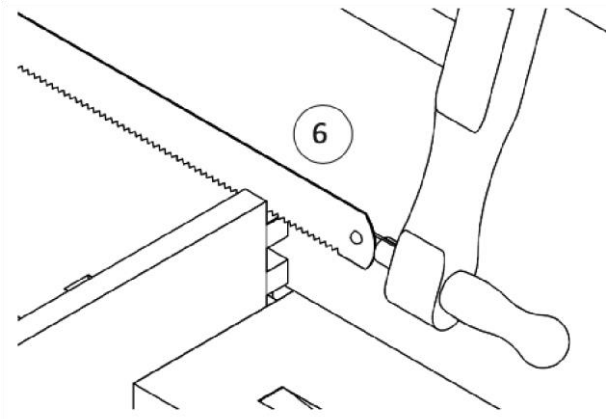
4) Calculate the numbers of fingers.

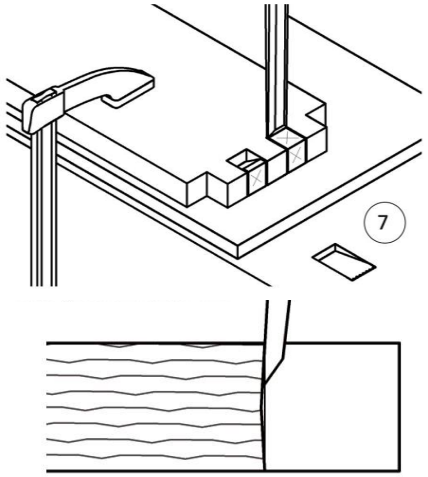
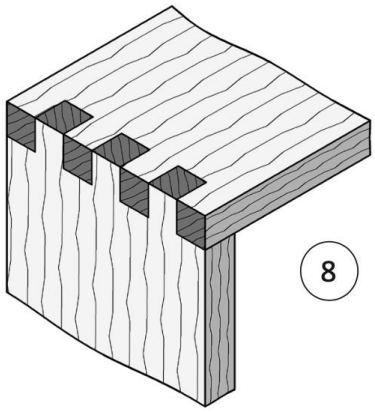
$$\frac{Width\ of\ the\ material}{thickness\ of\ the\ material}$$

The result must be an uneven number.

Choose the scale for your ruler as it is convenient (1,2, or 3 cm) and multiply by the



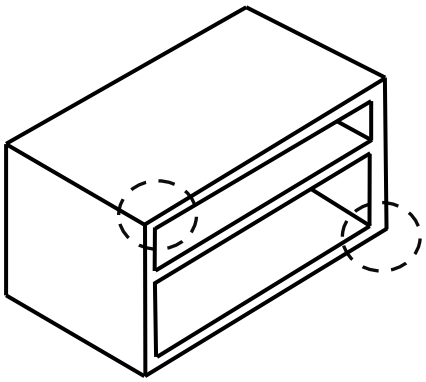
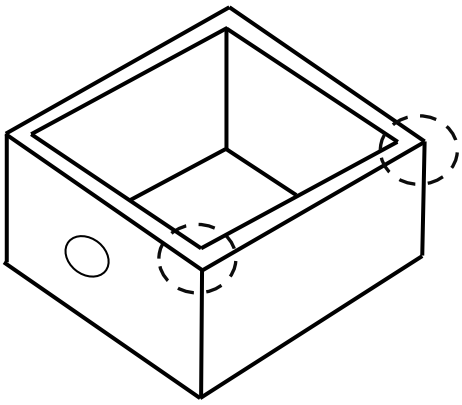
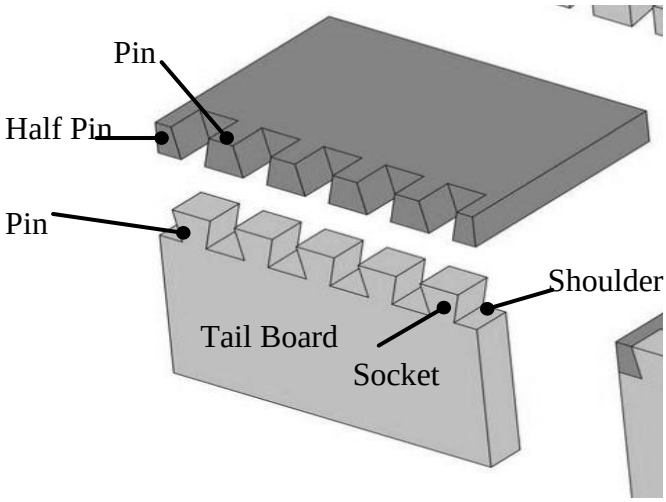
numbers of the fingers.	
	
5) Fix the work pieces in the workbench and cut on the waste side of the marking. (Indicate the waste with an **X)**	 
6) Cut the shoulder of the fingers at the side with the saw.	

7) Fix the work pieces on the workbench with a clamp and remove the waste with a chisel. Use the chisel from both sides, turn the work piece around. Remove the waste with a slight bevel to ensure a proper fitting.	
8) Make a dry assembly Dry assembly is done for each corner joint individually. By carefully assembling the fit of the parts will be determined. Fittings that are too narrow will reworked with the chisel (caution risk of injury!) A processing with rasps, files or sandpaper is not recommended.	

4.3 Dovetail Joint

4.3.1 Overview

Description:	A dovetail joint is commonly used in woodworking joinery including furniture, cabinets, log buildings, and traditional timber framing. One of the biggest advantages is the resistance to being pulled apart because of its wedge design. Once glued, a wooden dovetail joint requires no mechanical fasteners.

Application:		
Illustration:		

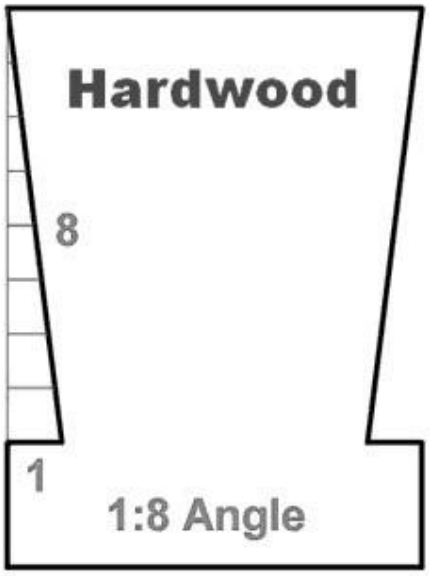
Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**Good**	**Difficult**
Plywood	**Medium**	**Medium**	**Medium**
Block board	**/**	**/**	**/**
Chipboard	**/**	**/**	**/**
MDF	**/**	**/**	**/**

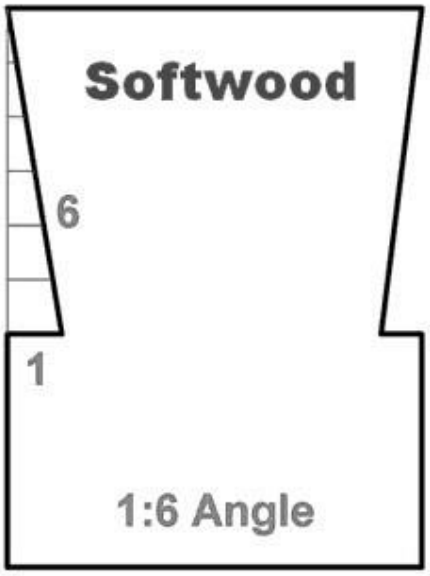
4.3.2 Dovetail - Introduction

The dovetail joint is very strong because of the way the 'tails' and 'pins' are shaped. This

makes it difficult to pull the joint apart and almost impossible when the joint is glued. This joint is used in box constructions such as drawers, cabinets and other pieces of furniture where strength is required. It is a difficult joint to make manually and needs a good level of skill.

The angle of slope of the dovetail varies according to the wood used and the purpose of the joint. Typically, the slope is 1:6 for softwoods and a 1:8 slope for hardwoods.





Advantages:

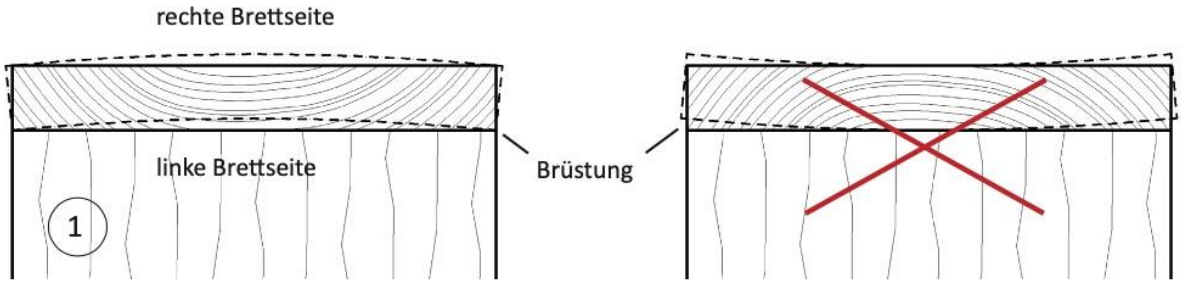
- Very strong joint, useful when parts are exposed to “pulling”.
- The dovetail joint gives an attractive lookout.
- The joint may be reinforced by gluing.

Disadvantages:

- Difficulty in making it, due to the precise and tight cutting required.
- Difficult to make with machines.

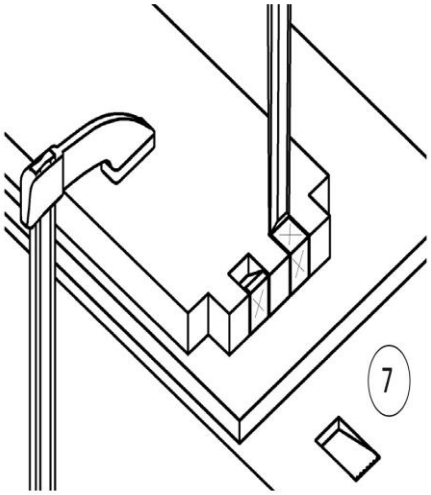
4.3.2 Dovetail Join – Step-by-Step-Guide

1) Arrange the parts according to the annual rings to make sure that the shoulders are not developing a gap after drying.

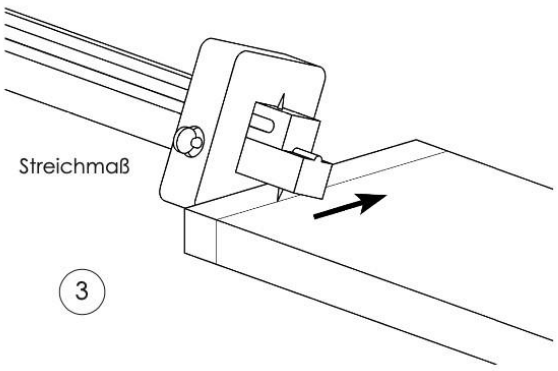


2) Get the parts organized and marked with the triangle system.

Keeping project parts organized and in proper relation to one another. Once you have dressed your work pieces to thickness, width, and length, orient them and mark the faces with sections of triangles. This quickly identifies the face, top, bottom, left and right sides of a project.



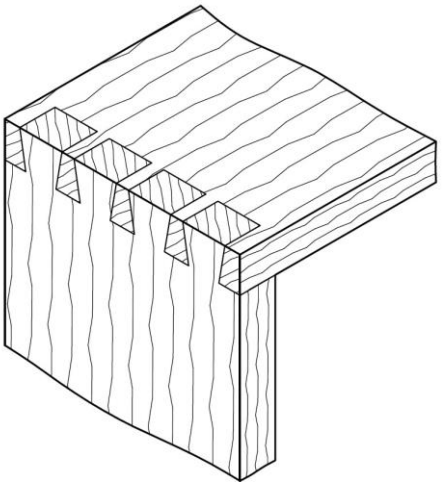
3) The wood thickness at all board ends is determined with the marking gauge moved parallel to the end grain. Lines will only be applied where it will be sawn and chiselled because it's difficult to remove the marking later. Note: The marking gauge should always be drawn towards your body; it provides much better control.



4) Marking

There are different methods existing to mark the dovetail joint.

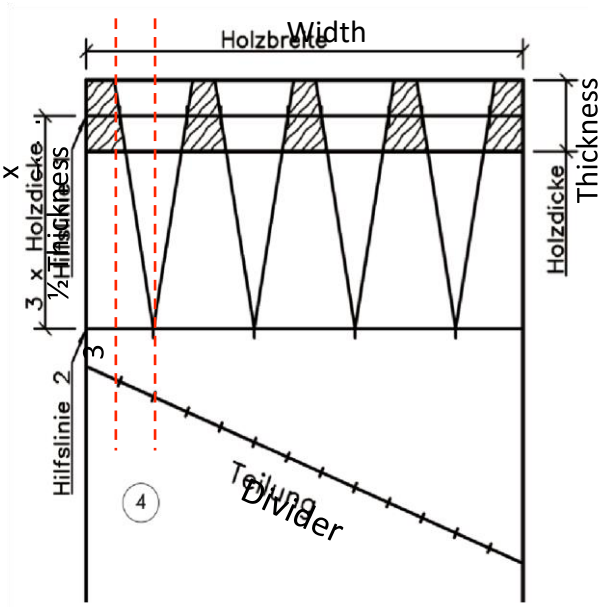
Only one method will be explained in this documentation.

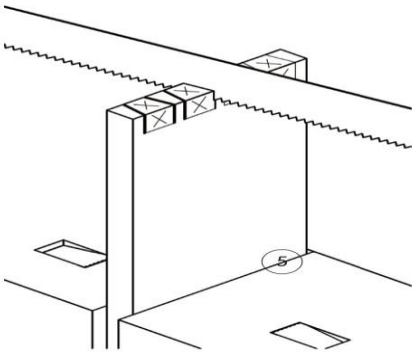
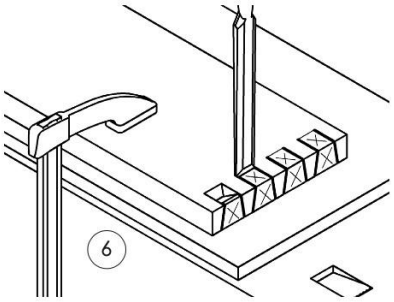
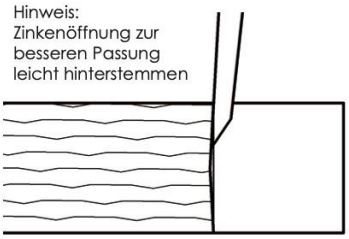
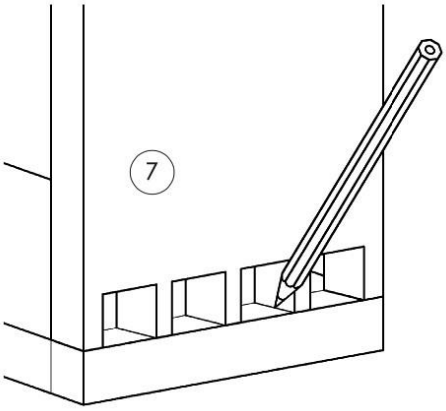


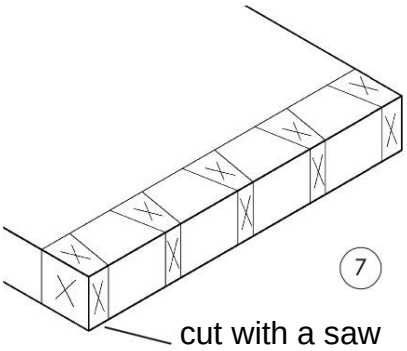
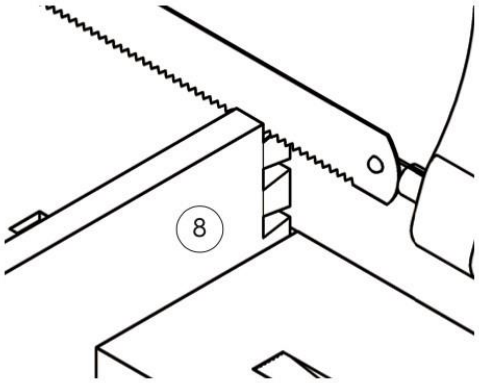
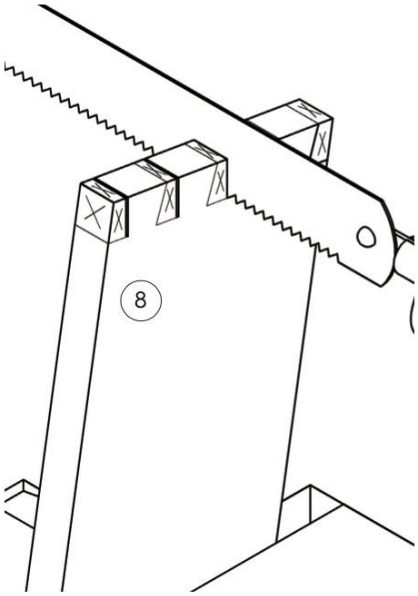
$$\frac{Width}{3} \; x12 \; Thickness = Numbers\ of\ Dovetails$$

$$Numbers\ of\ Dovetails\ x\ 3+1 = Divider$$

- Mark the Thickness
- Mark the line with half the thickness the tail part
- Mark the base line (Nr. 2)
- Mark the number of Dovetails on the baseline
- Mark the divider on the baseline and the middle line
- Mark the lines with a pencil



5) Cut along the markings on the waste side of the marking. Make sure that you are not cutting to deep.	
6) Fix the work pieces on the workbench with a clamp and remove the waste with a chisel. Use the chisel from both sides, turn the work piece around. Remove the waste with a slight bevel to ensure a proper fitting.	 
7) Marking and cutting the pins 1. Place the dovetail piece, on the bench in a horizontal position. 2. Place the pin piece upon the end of dovetail piece, as indicated. It is important that they exactly fit with the corner of the work piece.	

8) Mark the waste with an **X** cut with a saw	
9) Cut along the markings on the waste side of the marking. Make sure that you are not cutting to deep.	
10) Cut along the markings on the waste side of the marking. Make sure that you are not cutting to deep. Fix the work pieces on the workbench with a clamp and remove the waste with a chisel. Use the chisel from both sides, turn the work piece around. Remove the waste with a slight bevel to ensure a proper fitting. Make a dry assembly, if the fitting is to tight use the chisel carefully to remove some	

material wherever it is necessary.	

4.4 T- Joints - Key Mortise and Tenon

4.4.1 Overview

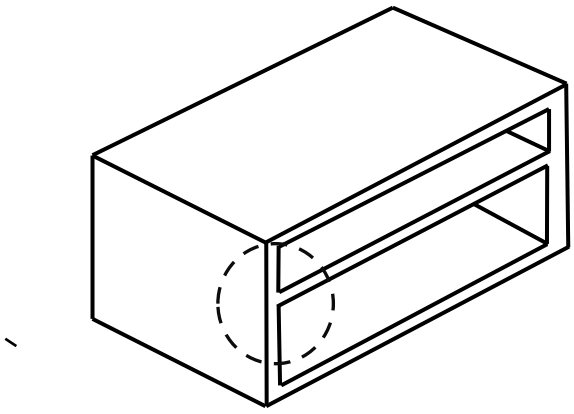
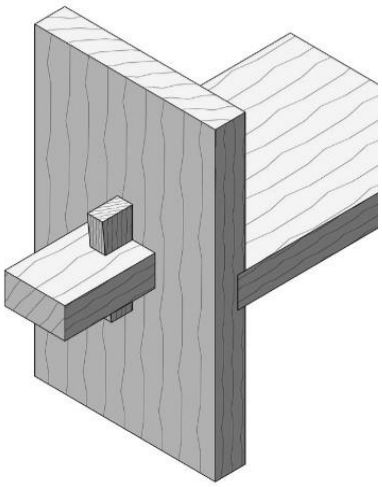
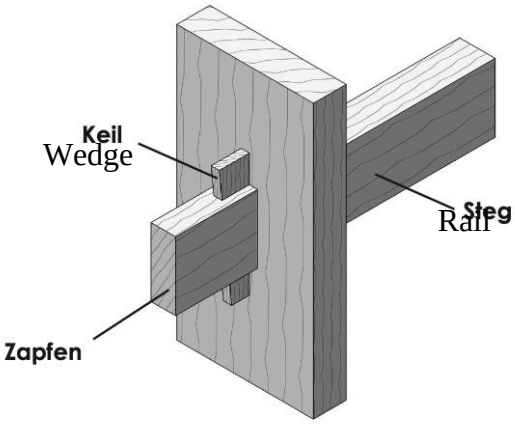
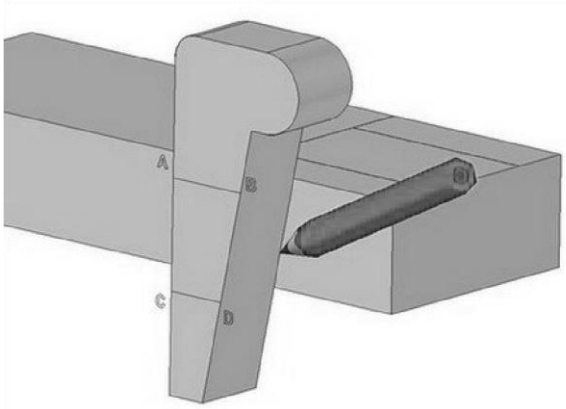
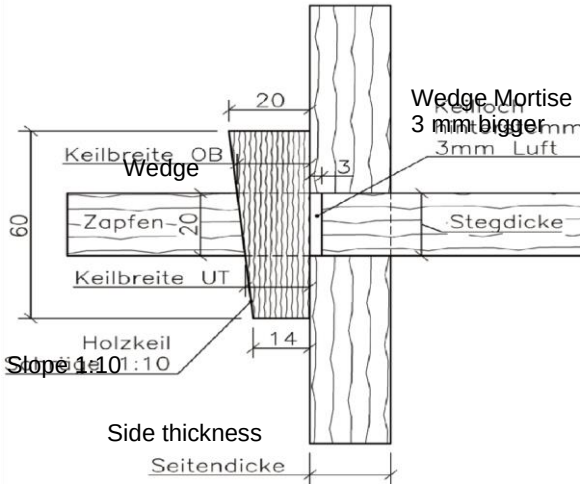
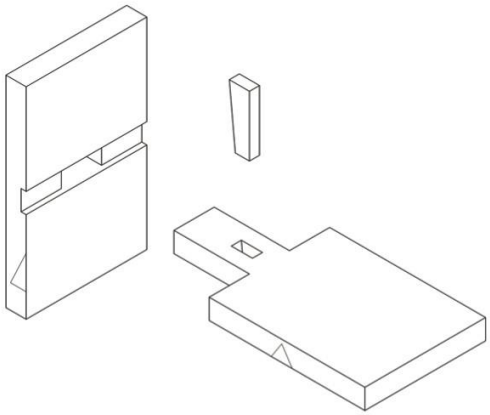
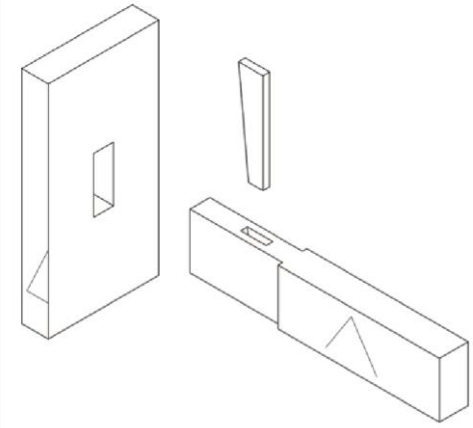
Description:	**An extended Tenon comes through the mortise, and at the point where the Tenon clears the mortise, it is pinned in place by a wedge. This joint can be dismantled and put back together.**
Application:	

Illustration:	 

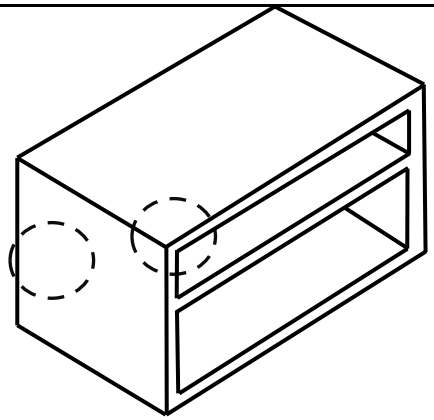
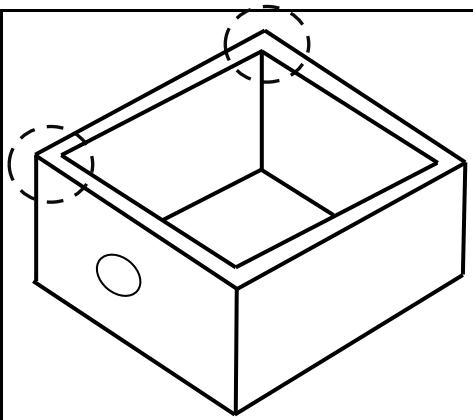
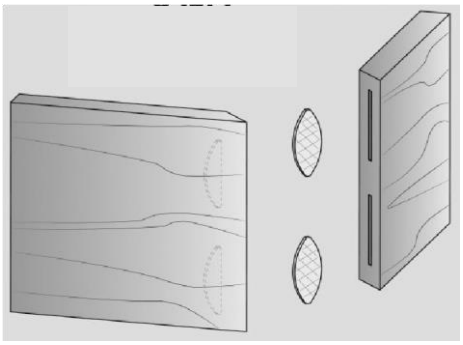
Material	Suitability	Hand Tool	Machine Tools
Solid Wood	Good	Medium	Medium
Plywood	/	/	/
Block board	/	/	/
Chipboard	/	/	/
MDF	/	/	/

4.4.2 T- Joints - Key Mortise and Tenon -Step-By-Step

1) The slope supposed to have a ratio of 1:10 	
2) Variation: Key Mortise and Tenon joint with grove to improve strength and reduce bending.	
3) Variation: Key Mortise and Tenon joint for Frame and Rail Constructions.	

UNIT 5. WOOD WORKING JOINTS FOR ENGINEERED WOOD PANELS

5.1 Biscuit joint

Description:	A biscuit joined works as a reinforced but joint. It is similar to a dowel joint, but instead of a round dowel fitting in a hole, a flat oval plate (the biscuit) made of compressed beech is fitted into a matching slot. With the addition of water-based PVA glue, the biscuit expands to fill the slot forming a very strong joint. The biscuit jointer itself is a small-scale plunge soar with his circular-saw-blade, specifically developed for trimming panels or cutting grooves for drawer panels. It works for corner, Mitre and T -joints.	
Application:		
Illustration: **Mitre biscuit joint**		

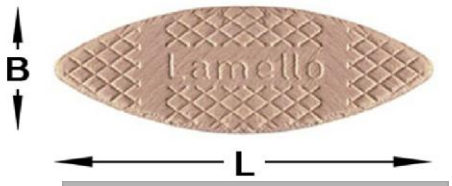
Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Good**	**/**	**Easy**
Plywood	**Good**	**/**	**Easy**
Block board	**Good**	**/**	**Easy**
Chipboard	**Very Good**	**/**	**Easy**

MDF	**Very Good**	**/**	**Easy**

The safest and best way to cut biscuit slots into the work pieces is with a biscuit joiner. This hand held machine is designed to do produce slots or grooves. The biscuit joiner's cutter retracts inside the tool as you pull it away from your work pieces. After making the oval shaped grooves a biscuit, fits into a pair of matching slots.

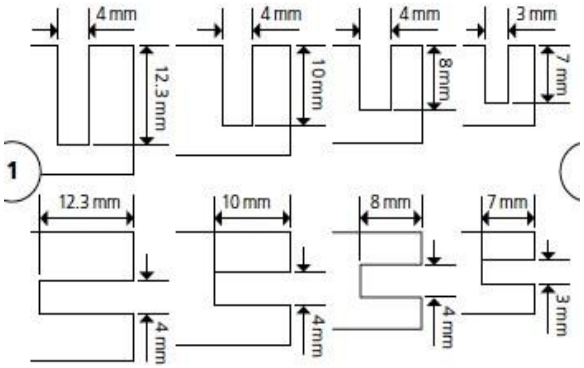
An alternative is to produce the slot with a spindle moulder or with the table saw.

Standard sizes of the biscuits.



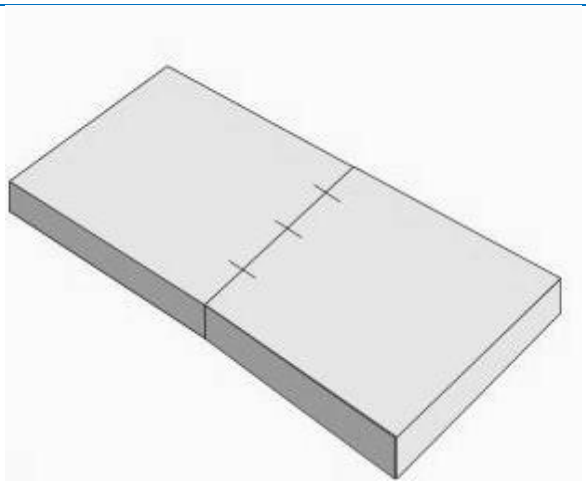
	L	B	Thi.
Size 0	47	15	4
Size10	53	19	4
Size20	56	23	4

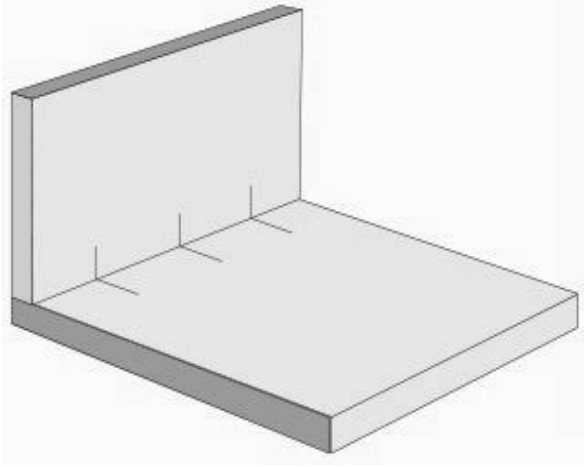
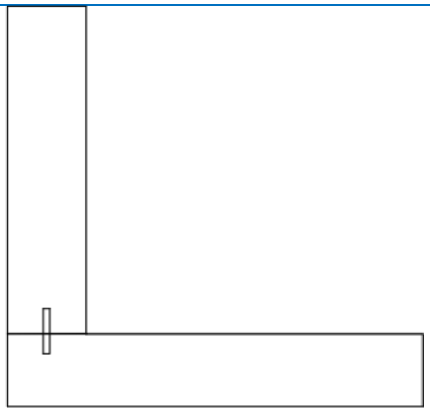
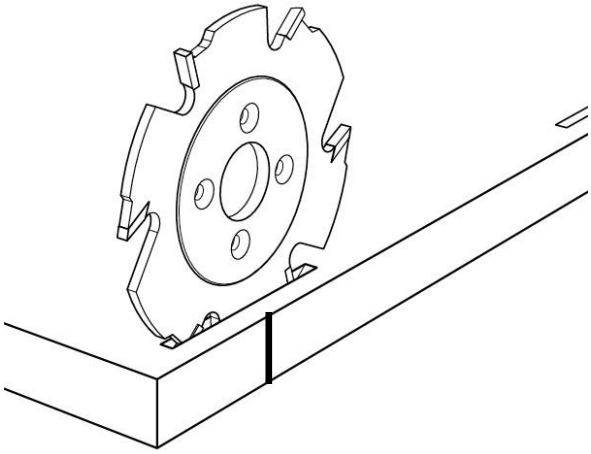
The corresponding slot dimensions

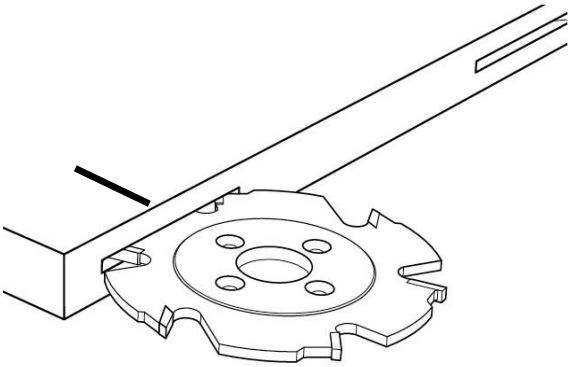
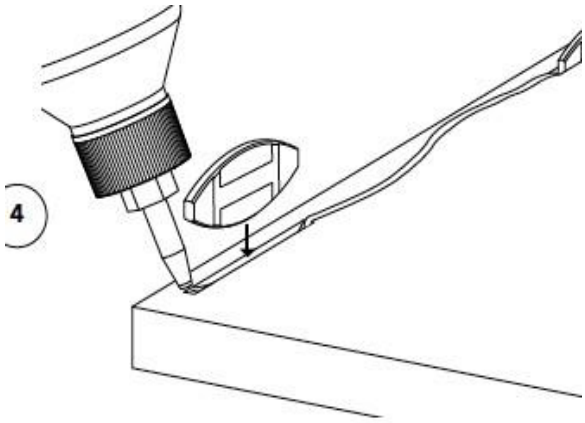
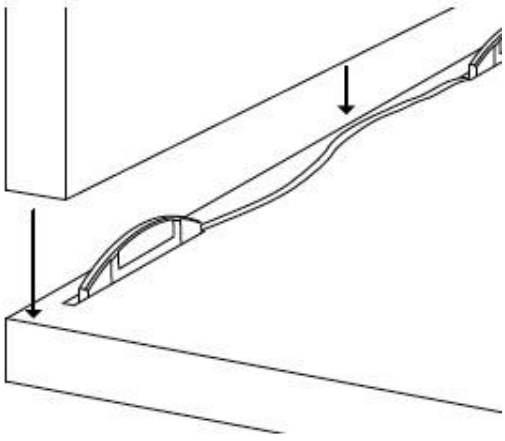


1) Marking of a biscuit join

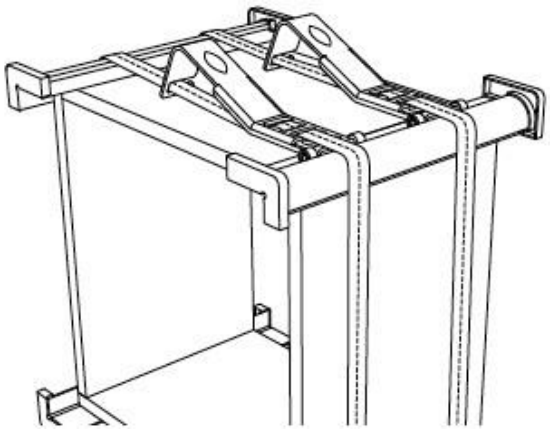
Draw the central line of the joint on the work, then mark along add the central point of each biscuit slot, spaced about 100mm apart. Set the cutting depth of blade to match half the width of the biscuits being used plus 1 mm and adjust the tools fence to align the blade with a market centered line.



2) Marking of a biscuit join corner joints/T-joints Draw the central line of the joint on the work, then mark along add the central point of each biscuit slot, spaced about 100mm apart. Set the cutting depth of blade to match half the width of the biscuits being used plus 1 mm and adjust the tools fence to align the blade with a market centered line.	 
3) Cutting corner-joint slots Before making the cut, align the cutting guide mark on this side of the fence with a central point of each slot. Keeping offense pressed against the edge of the wood, switch on and plunged the blade to cut the slot.	

4) Cutting matching slots To cut the other half of the joint, mark the matching biscuit-slot centers on the end of the second work piece and clamp it on a flat surface. Turn the guide fence over and lay the jointer on its side, then adjust the fence to center the blade on the edge of the work piece	
The best glue for biscuit joints are water based glue like pave because the biscuits are going to expand. Because the biscuits expand quickly, do a dry assembly and make sure everything's set before you apply the glue. Remove any sawdust from the slots, test fit your biscuits, and dry-assemble the panel. If everything fits like it should, you're set to reassemble it for good with glue.	
If everything fits like it should, you're set to reassemble it finally with glue.	

Use clamps or band clamps depending on the project.

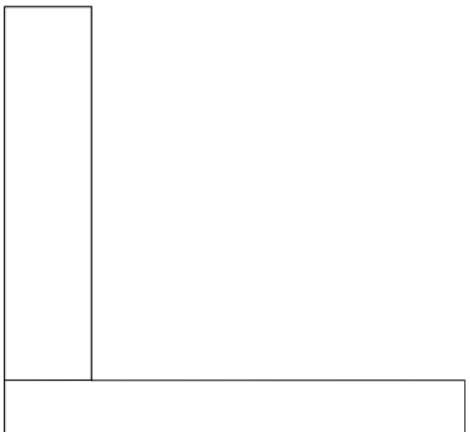


Biscuit-jointer safety

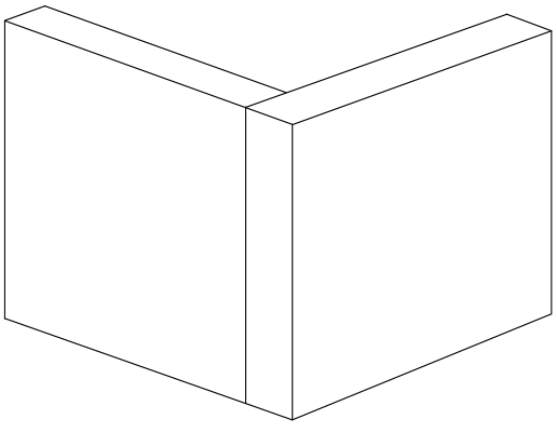
As well as observing the standard working methods for power tools, note the following points with specific reference to biscuit jointers.

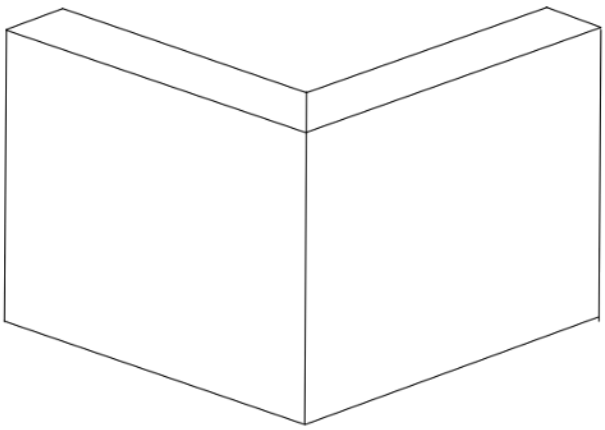
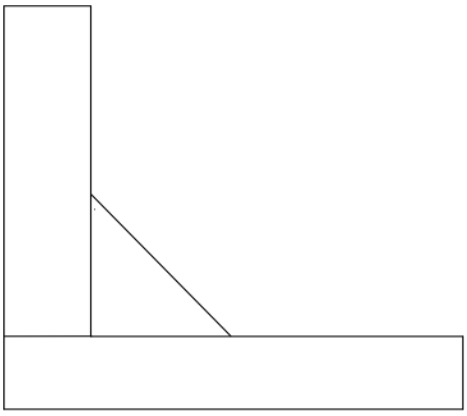
- Remove and throw cracked or bent blades and replace with sharp ones.
- The motor must be running before you plunge the blade into wood.
- Do not attempt to slow down or stop a spinning blade by applying pressure from the side.
- The blade guard must always be in place when the jointer is running. When cutting a groove, always feed the joints are away from you.

5.2 Alternative Joints



Square-Ended Butt Joint

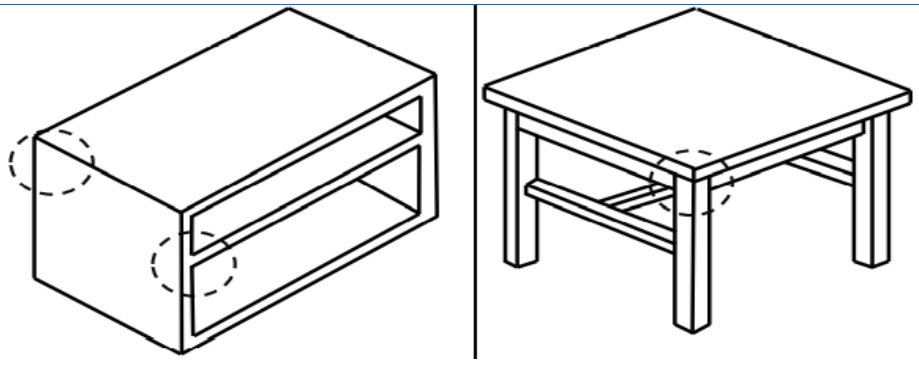


Mitred Butt Joint	
Lap Joint	
Butt Rub Joint	

UNIT 6. KNOCK DOWN JOINTS

6.1 Knock Down Fasteners

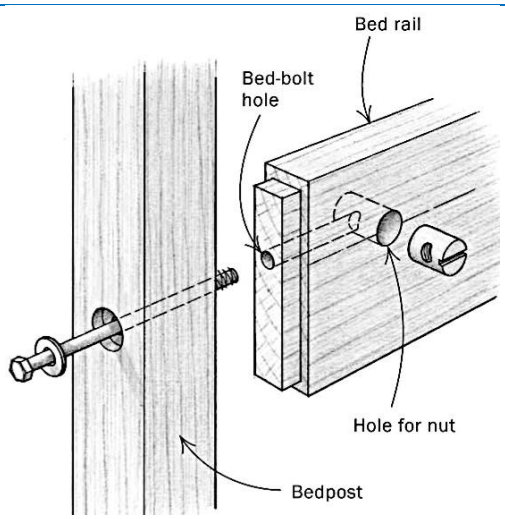
6.1.1 Introduction

Description:	Knock-down fasteners are designed to allow for repeated assembly and disassembly. They are often used in flat pack furniture, like book cases and wall units that come in a package of pre-cut and pre-drilled components ready to be assemble. Knock-down fasteners are typically used for carcase joinery; furniture designs using them are usually of frameless construction. The Application in cabinet making depending on the type of fastener. Particularly in carcase construction (e.g.. Carcase sides to top and bottom, fixed shelving/partitions, drawer boxes, counter tops to carcase) There are various kinds of fasteners on the market. **Advantages**: • Knock-down fasteners can be assembled with a simple tool like an Alan key. • They self-align when tightened, and allow for a secure connection without requiring drilling or gluing when it is assembled. • Big components, which are difficult to assemble, can be connected.
Application:	

Material	Suitability	Hand Tool	Machine Tools
Solid Wood	**Very Good**	**/**	**Easy**
Plywood	**Very Good**	**/**	**Easy**
Block board	**Very Good**	**/**	**Easy**
Chipboard	**Very Good**	**/**	**Easy**
MDF	**Very Good**	**/**	**Easy**

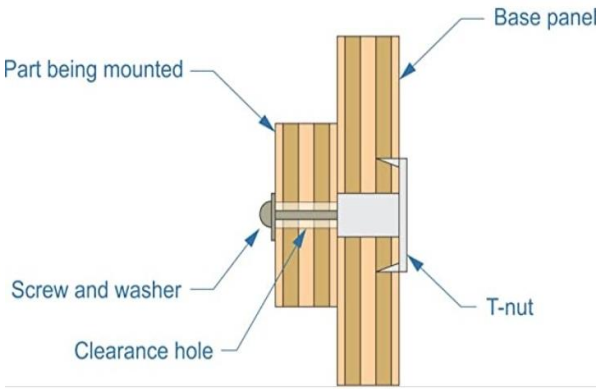
Bolt and Barrel Nut

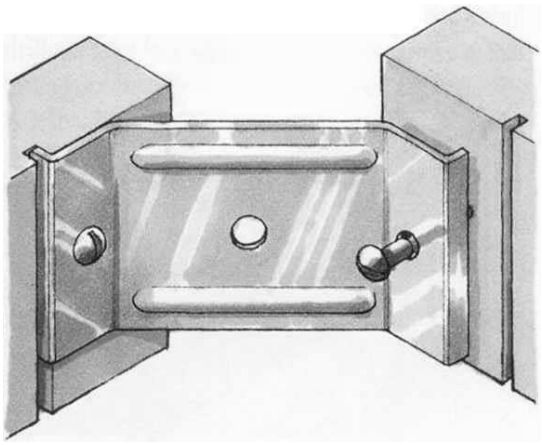
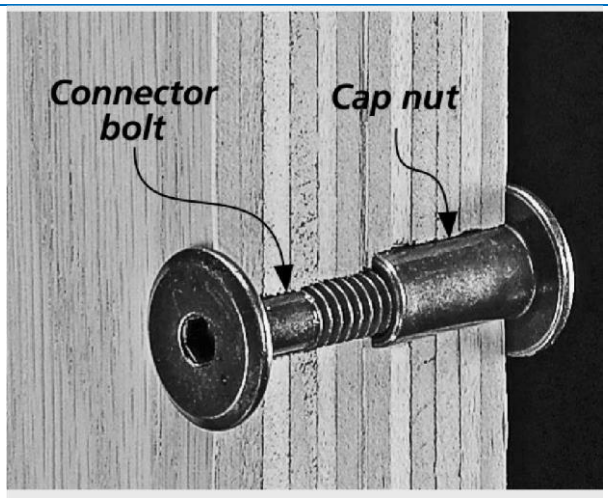
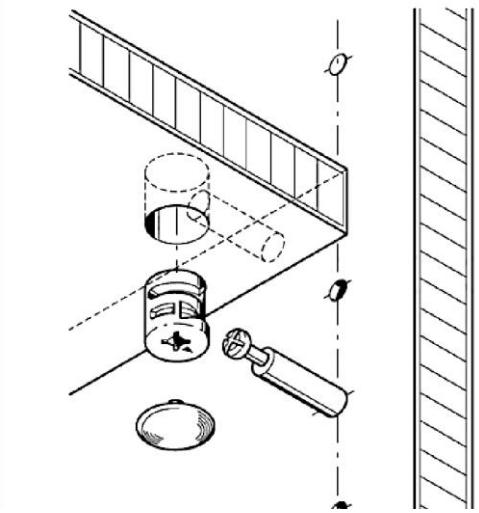
This is a strong and simple joint. It can be reinforced with wooden dowels or short Tenons. It is very suitable for frame assembly like bed or table constructions.



Tee Nuts and Bolts

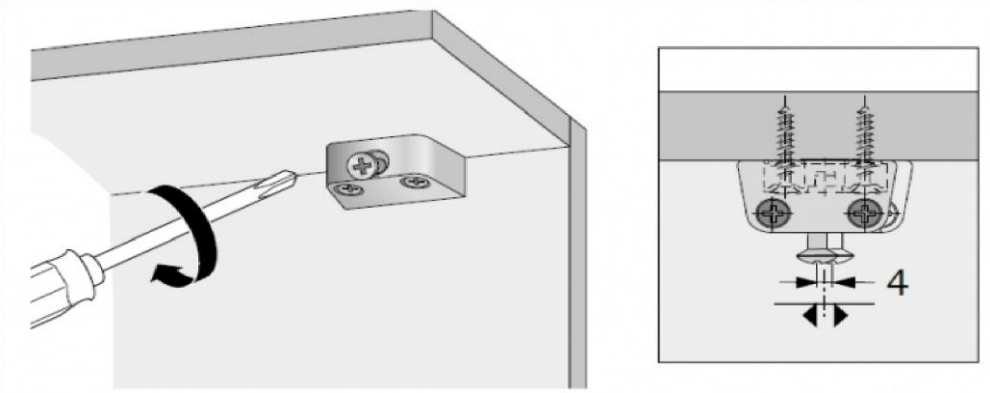
Application: Upholstery frames, application with hidden backside



Corner Plates are joints between table legs and rails. It can be fixed with a screw or reinforced with slots to mount the corner plate. **Application: Tables, Beds**	
Screw connectors Cabinet connectors bolt together cabinet parts and keep them aligned. The bolt passes through a hole in one side panel into the ribbed 'nut', which fits tightly in a hole drilled in the neighbouring panel. The fitting is removable.	
Cam Fittings are almost invisible after the carcasses are assembled. The dowel pin is screwed into the side, and the horizontal panel is fitted from the underside.	

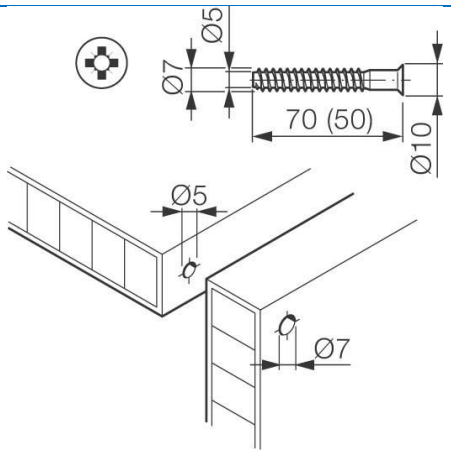
Block Joints

Made from plastic or aluminium produce a simple but strong corner joint. It can be dismantled with a screwdriver. One side will be screwed or mounted with dowels.



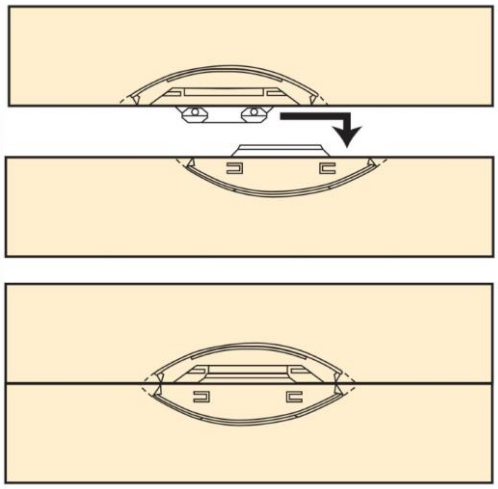
Chipboard fasteners

Special designed screws for secure butt joints. It is important to apply the precise diameters according to the specifications. The joints can be improved by using additional wooden dowels



Screw sockets

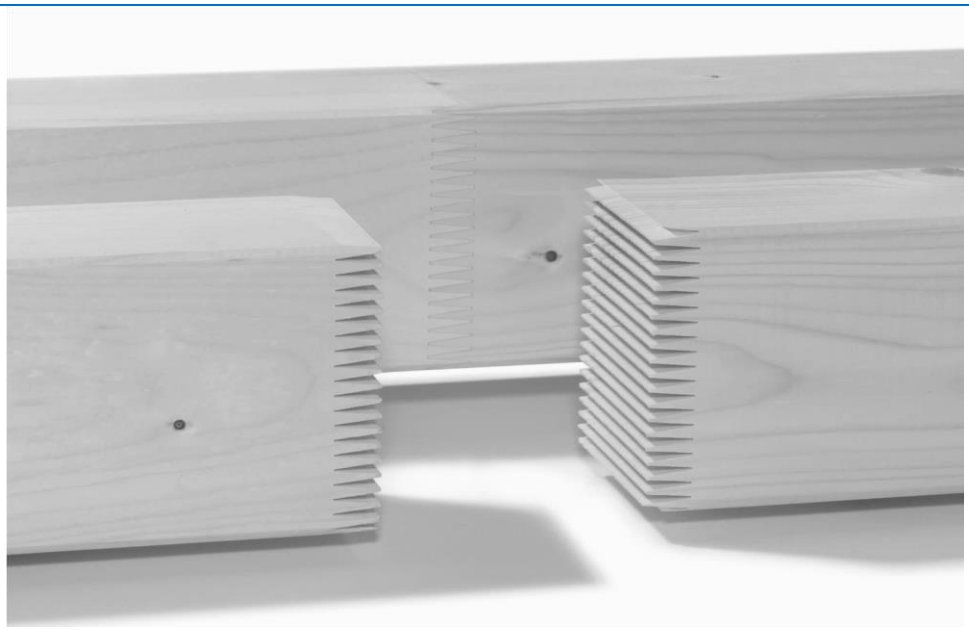
Metal screw sockets provide secure fixing points for bolting together wood frames or panels.

Biscuit Fasteners Biscuit fasteners can be applied like biscuit joints. Additionally, they offer self-locking features and work without glue.	

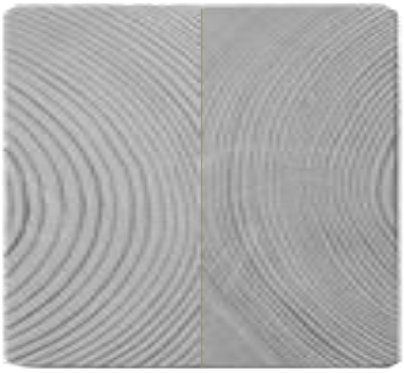
UNIT 7. HANDLING AND PROCESSING OF SOLID WOOD PANELS AND BEAMS

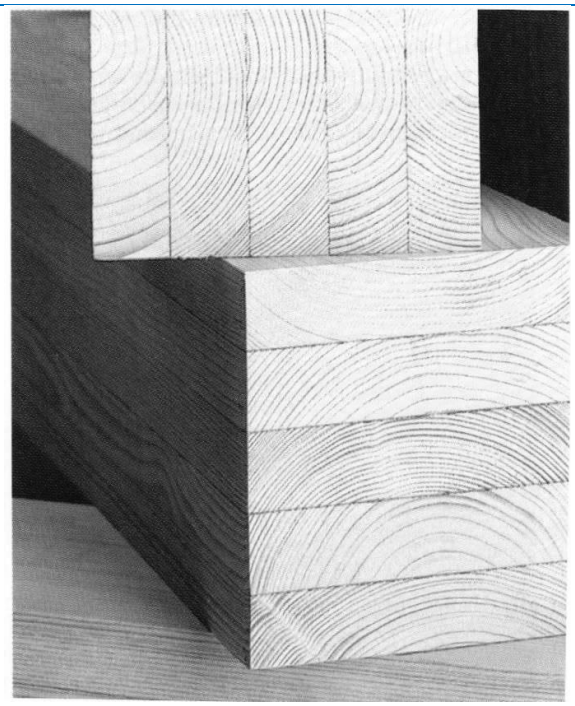
7.1 Relevant solid wood panels and beams

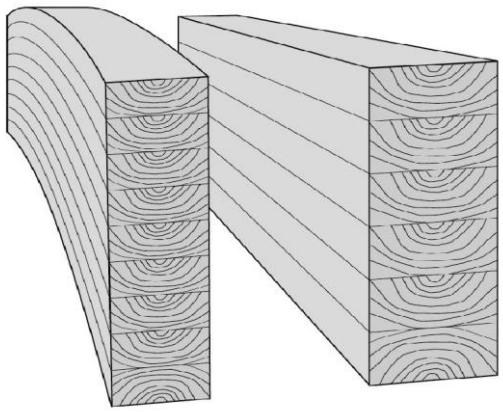
Description:	**Finger-jointed solid construction timber** Finger-jointed solid timber is graded, kiln-dried and planed solid timber. It can be manufactured in almost any length. Laminated solid wood optimizes the structural values of wood. Because of their composition, large glulam members can be manufactured from a variety of smaller trees harvested from second growth forests and plantations. Glulam provides the strength and versatility of large wood members without relying on the old growth-, solid-sawn timbers. As with other engineered wood products, it reduces the overall amount of wood used when compared to solid sawn timbers by diminishing the negative impact of knots and other small defects in each component board. Shorter length can be joined by finger - joints. The structural construction timber needs to manufactured according to high standards and quality control. Specifications for finger-jointing are given in EN 15497. Finger-jointed solid timber is classified into strength classes by visual or machine grading according to EN 14081-1. This standard defines performance requirements and also sets a maximum wood moisture content of 18%. The adhesive used to bond the lamella has to fulfil the requirements of load-bearing structural timber components. The natural durability against biological attack of this type of timber product depends on the wood species used. **Advantages:** • Long dimensions optional • Higher recovery rate

	• High loadbearing capacity with a low density • High dimensional stability through technical drying • High fire and chemical resistance • High thermal insulation properties • Positive impacts on climate protection through storage • of carbon dioxide
Illustration:	

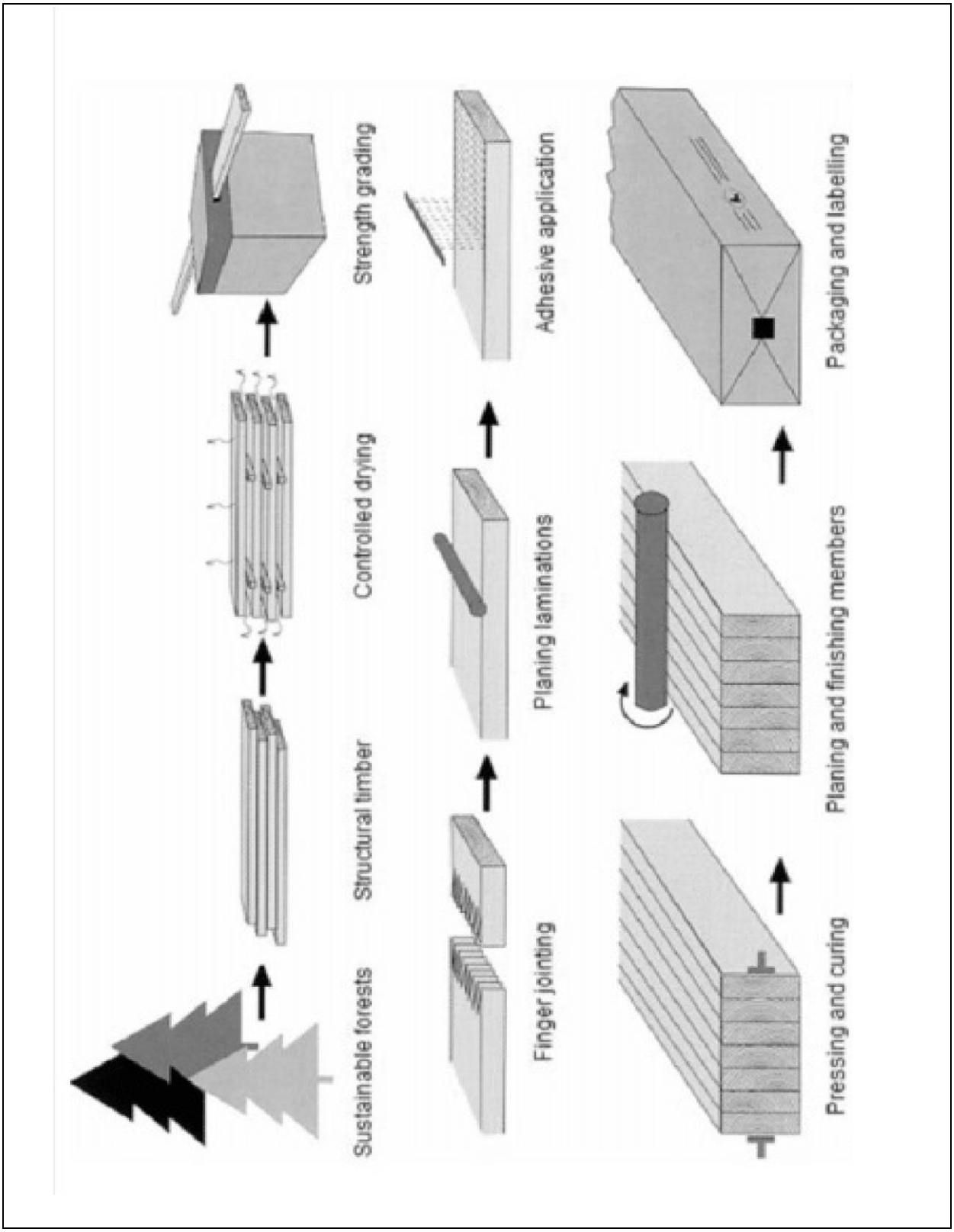
Roof and Wall Construction

Glue Solid Timber with Finger-joints	**Solid Wood** 
Glue Solid Timber with Finger-joints/2 Lamellas consist of lamellae of the same species and thickness.	

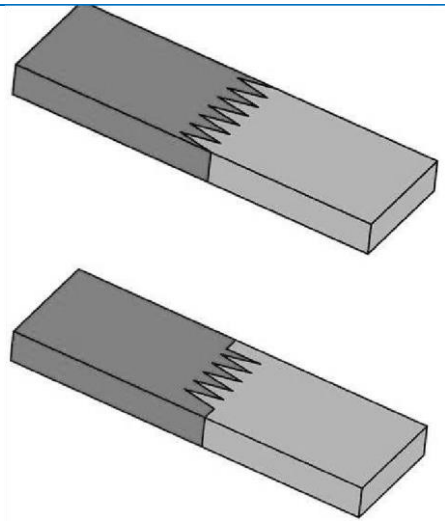
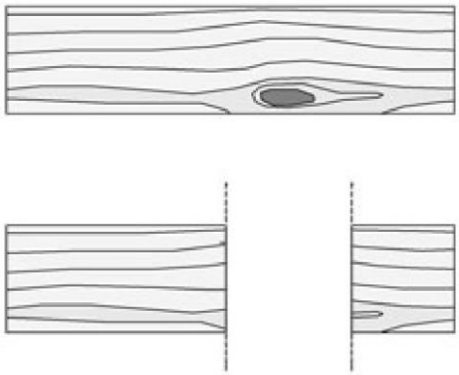
Glue Solid Timber with Finger-joints/3 Lamellas consist of 3 lamellae of the same species and thickness.	
Glue laminated timber (Glulam) is an industrially manufactured building product for load-bearing structures. It is made of board lamellas, which are finger jointed lengthwise and then glued together with parallel fibres. • The load-bearing capacity is greater than with solid wood, as defects (knots etc..) are cut out in advance and a homogeneous cross-section is created by the gluing. • Finger-jointing allows longer beam lengths • The glued joints from glulam must be produced with special care. (climate (temperature and humidity)	

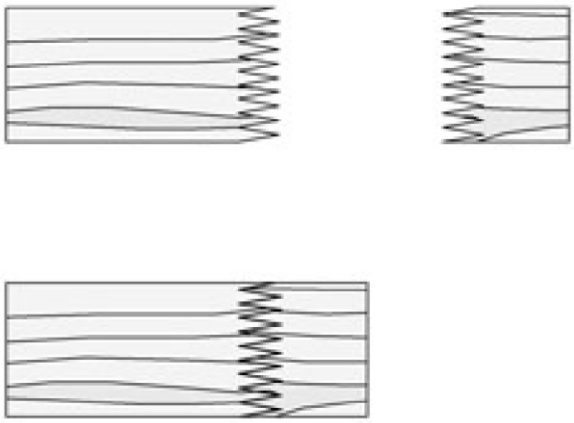
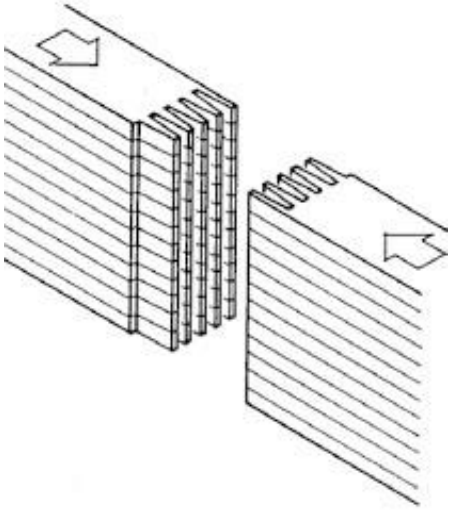
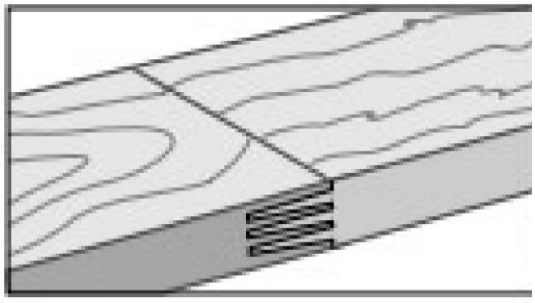
Glulam can be manufactured in many shapes, including straight, curved and camber beams	

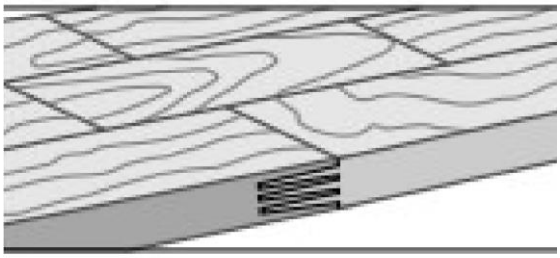
7.2 Manufacturing process Glue Solid Timber with Finger-joints



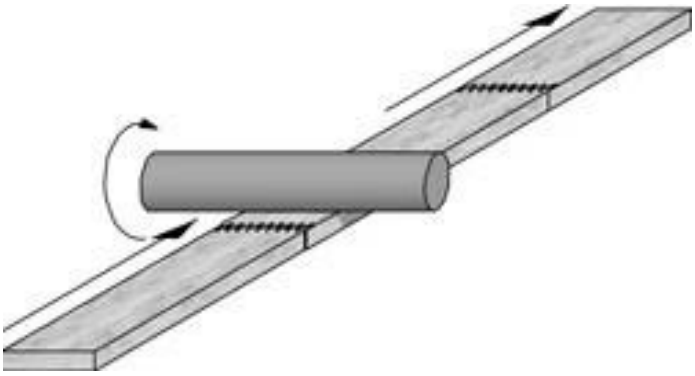
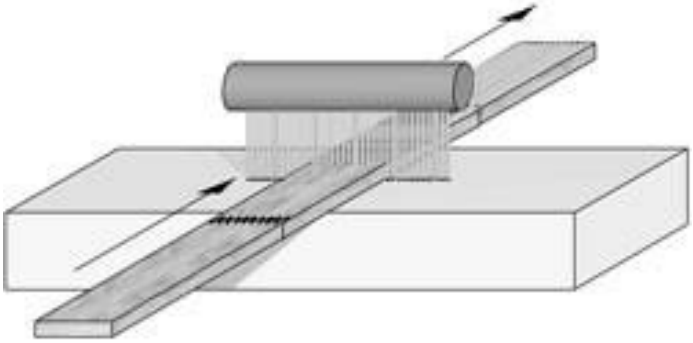
7.3 Joints across the grain

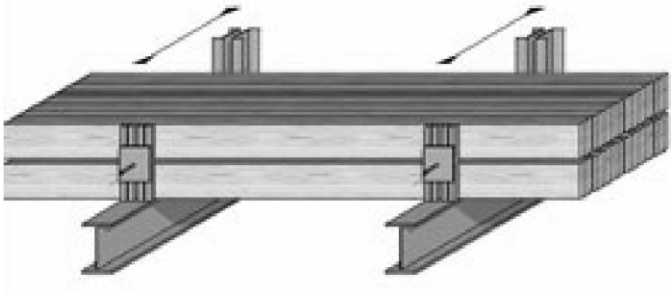
Finger joint plate (board), also known as a comb joint, is a woodworking joint made by cutting a set of complementary, interlocking profiles in two pieces of wood, which are then glued. The cross-section of the joint resembles the interlocking of fingers between two hands, hence the name “Finger joint”. The sides of each profile increase the surface area for gluing, resulting in a strong bond, stronger than a butt joint but not very visually appealing	
Step 1 Selection and preparation of material	

Step 2: Measuring finger Joints and cut-outs, cutting the finger joints	
Step 3: Formation of a joint profile	
Step 4: Application of adhesive Finger-jointed plate/board glue process: End-glued: short lengths are finger jointed and end-glued only; End-and edge-glued: Panels made up of random width finger-jointed stock glued edge to edge; Edge-glued: Panels made of full-length strips glued edge to edge	 **End-glued** Short lengths are finger-jointed and end-glued only.

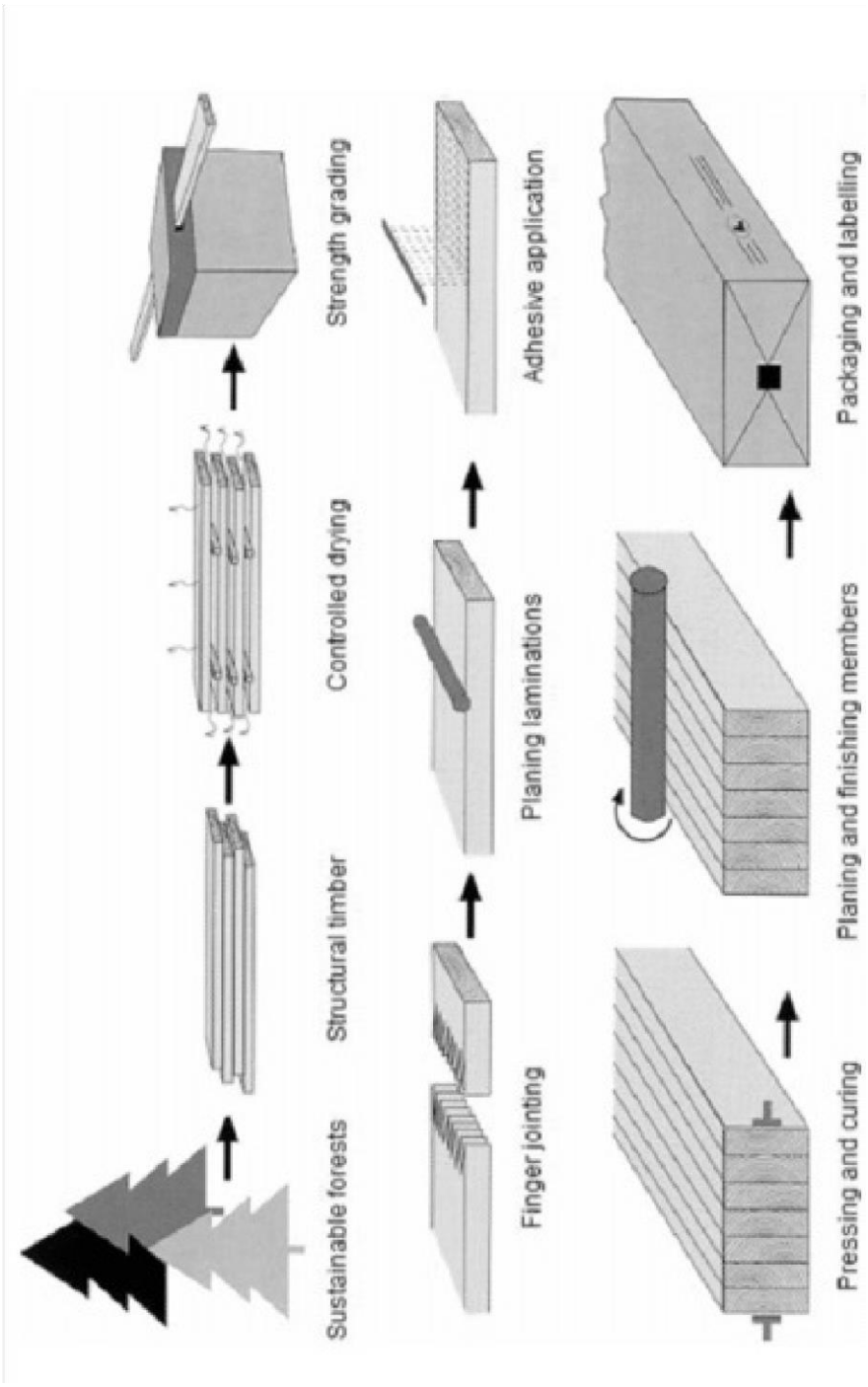
Step 5: Assembly of joint, **Step 6: Curing of adhesive.**	 **End- and edge-glued** Panels made up of random width finger-jointed stock glued edge to edge.

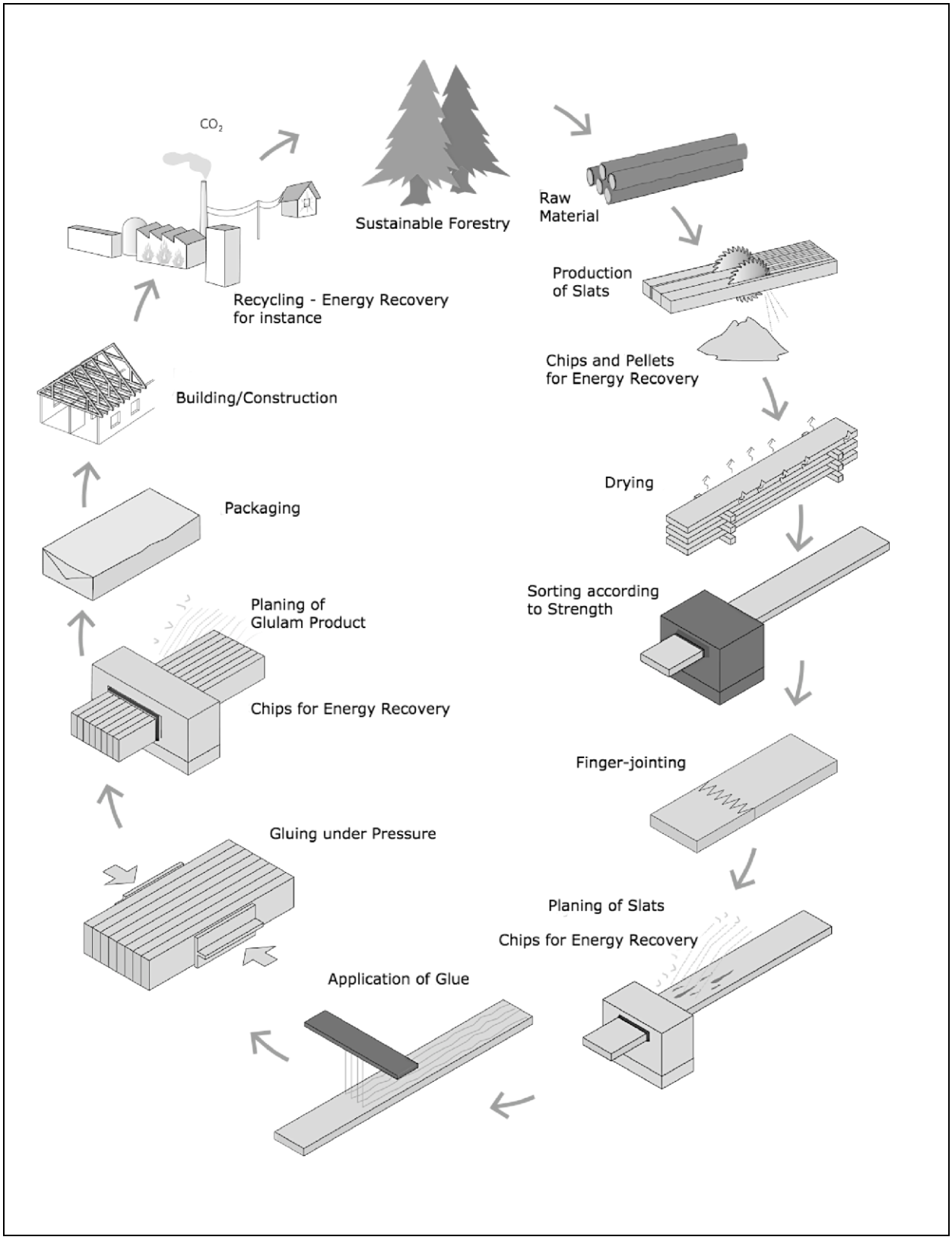
7.4 Gluing along the grain/Glue lam

Planing of the Lamellas After the finger joints have been hardened the lamellas are planed to the required thickness	
Application of adhesive Glue application on one side of the lamellas	

Assembly of the lamellas At least three lamellas are stacked and pressed in an either straight or curved press. **Planing of the glulam** After the glue lines are hardened the raw glulam is usually planed and chamfered.	

7.5 Manufacturing process Solid Timber with Finger-joints




CO_2
Sustainable Forestry
Raw Material
Production of Slats
Recycling - Energy Recovery for instance
Chips and Pellets for Energy Recovery
Building/Construction
Drying
Packaging
Sorting according to Strength
Planing of Glulam Product
Chips for Energy Recovery
Finger-jointing
Gluing under Pressure
Planing of Slats
Chips for Energy Recovery
Application of Glue

UNIT 8. WOOD WORKING JOINTS FOR ENGINEERED WOOD PANELS

8.1 Relevant Wood Based Panels:

8.1.1 Introduction

Wood-based panels refer to a variety of different board products made from wood in the form of chips, strips, veneers, strands or fibres. Examples of wood-based panels are:

- Block board
- Particle board
- Fibre board
- Plywood
- Oriented strand board (OSB).

These products are engineered to precise design specifications, which are tested to meet national or international standards and provide uniformity and predictability in their structural performance. Engineered wood products are used in a variety of applications, from furniture industry, home construction to commercial buildings to industrial products.

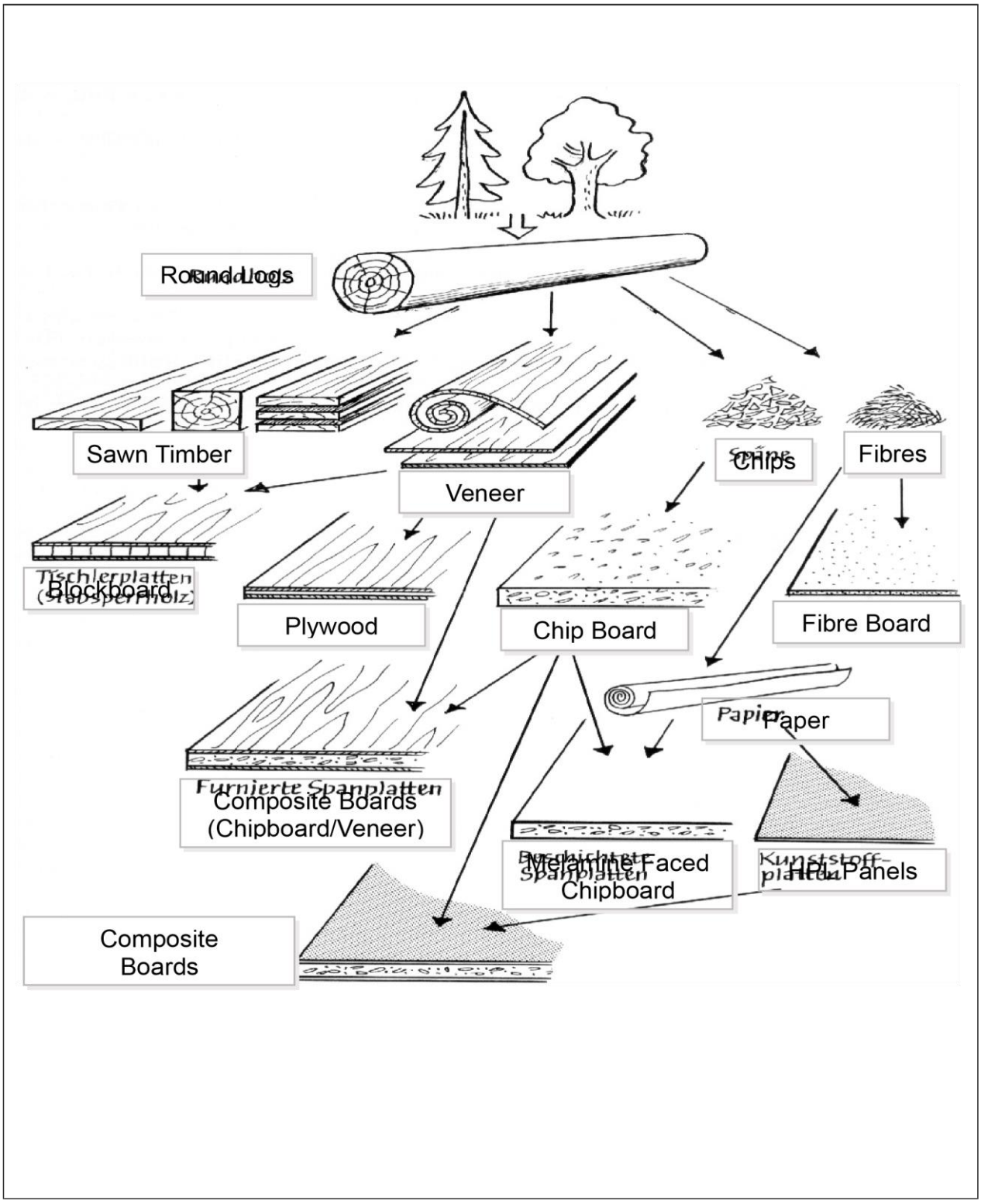
Typically, engineered wood products are made from the same hardwoods and softwoods used to manufacture lumber.

Sawmill scraps and other wood waste can be used for engineered wood composed of wood particles or fibres, but whole logs are usually used for veneers, such as plywood, Medium-Density Fibre board (MDF), or particle board.

Main advantages of wood based panels are:

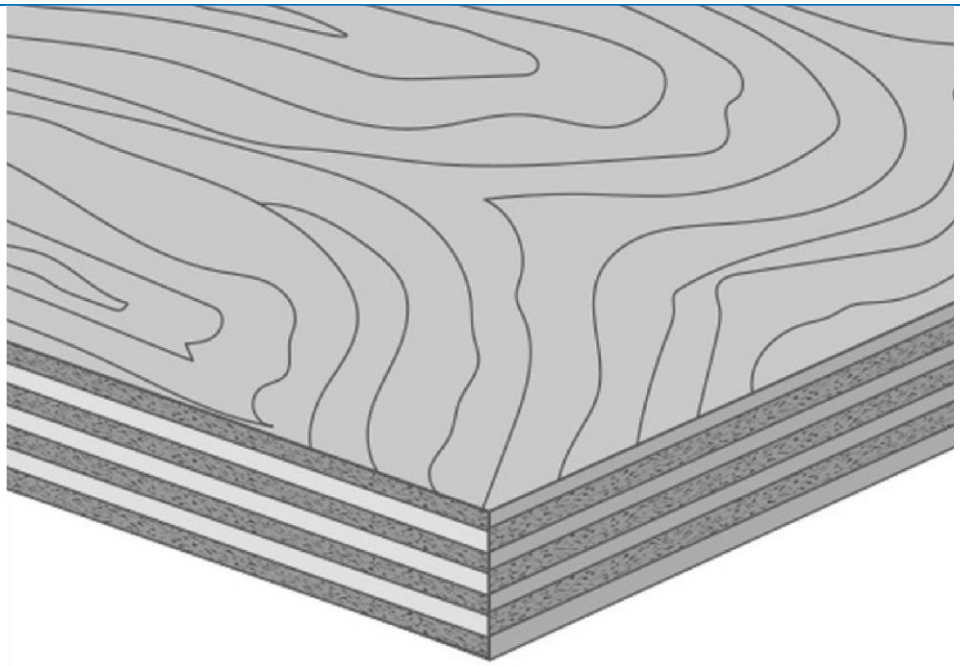
- The material becomes more homogeneous (swelling/shrinking/bending/deforming)
- Panels are having a greater dimensional stability
- Panels being available in bigger sizes
- Lower quality requirements for the raw material
- Price compared to solid wood lower
- Saving natural resources through higher recovery rates
  - Sawn Timber 40 - 50 % recovery rate

- Plywood 50 - 60 % recovery rate
- OSB 80 - 85 % recovery rate
- Particle Board 80 - 85 % recovery rate
- MDF 85 - 90 % recovery rate



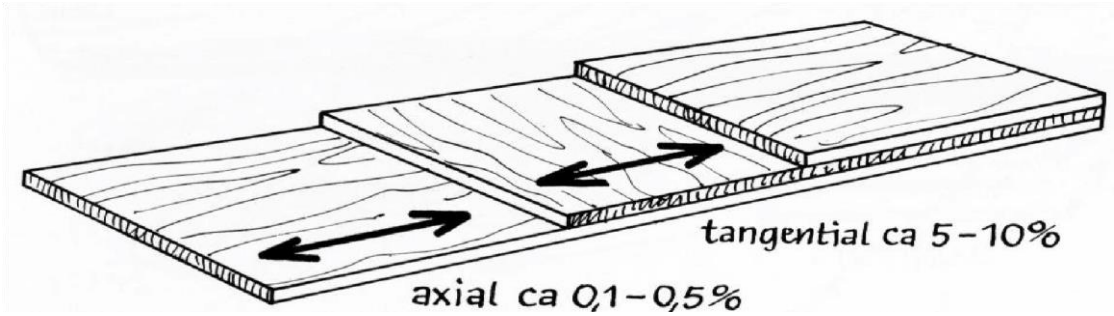
8.1.2 Plywood

Description:	Plywood is a material manufactured from thin layers or "plies" of wood veneer that are glued together with adjacent layers having their wood grain rotated up to 90 degrees to one another. All plywood bind resin and 'wood fibre sheets (cellulose cells are long, strong and thin) to form a composite material. This alternation of the grain is called cross-training and has several important benefits: • Minimise the tendency of wood to split • Minimise expansion and shrinkage, providing improved dimensional stability • Makes the strength of the panel consistent across all directions. • There is usually an odd number of plies, so that the sheet is balanced—this reduces warping. (3,5,7,9, x numbers of layers. • It is bonded with grains running against one another and with an odd number of composite parts, it has high stiffness perpendicular to the grain direction of the surface ply.

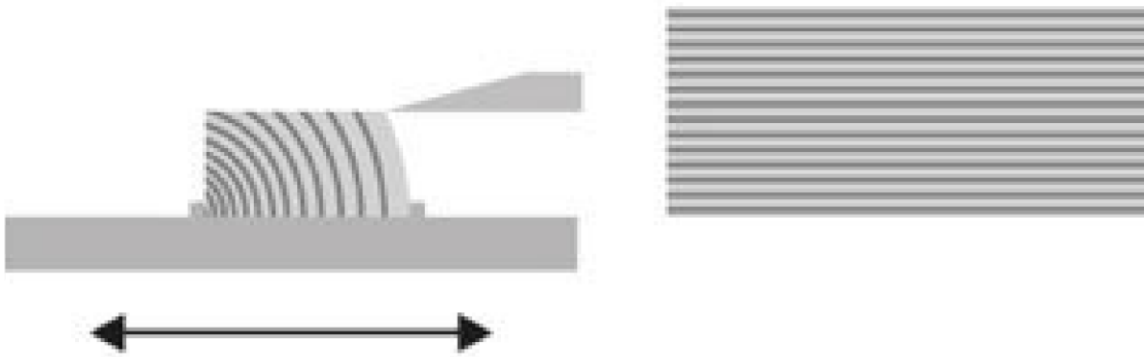
Illustration:	

3-Ply Plywood wood grain rotated up to 90 degrees to one

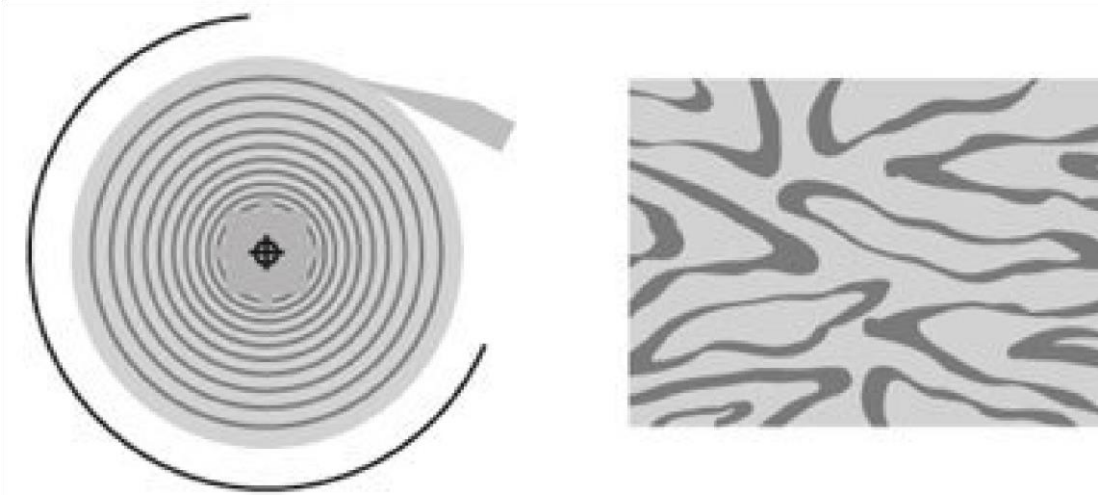
another



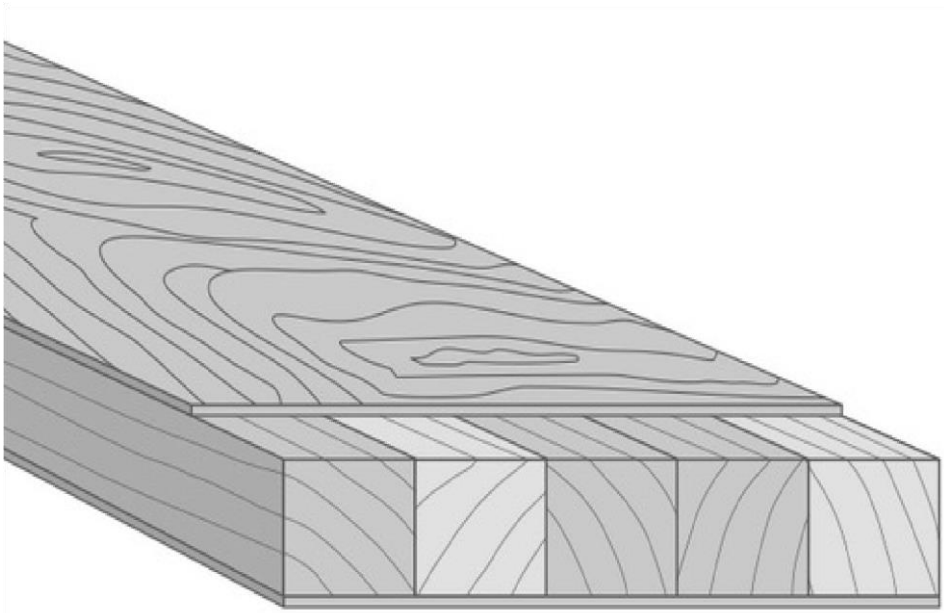
Veneer production of sliced veneer for decorative purpose



Veneer production of peeled veneer for panel production



8.1.3 Block board

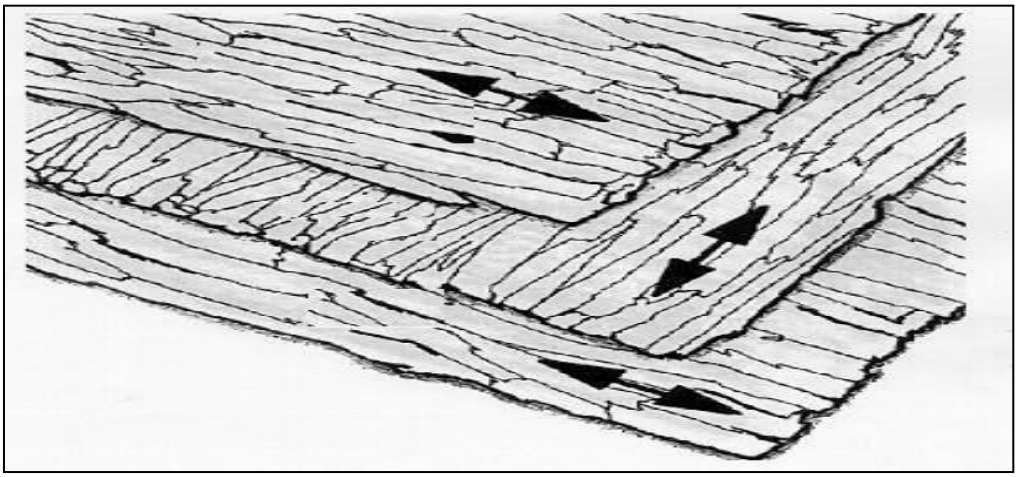
Description:	Block board is a sheet material that comprises a core faced on both sides with veneer. The core is made from parallel, rectangular section, bonded softwood strips these are sandwiched between a variety of facing materials which can include veneers of softwood, hardwood, thin MDF or particle board. The assembly is glued under high pressure. The construction can be three-layer – with a single facing on each side of the core, e.g. MDF or particleboard, or it can be five-layer for better stability – with two facings on each side. The grain of the facing material is usually arranged so that it is perpendicular to that of the core strips – which for reasons of strength run along the length of the board and are usually made from seasoned, lightweight timbers, such as poplar or spruce. Higher quality Block board has thin layers of core material. It improves the flatness of the surface and improves the dimensional stability.
Illustration:	

Description:	Particleboard is used as a general term for panel products that are made with wood particles. The type of particle is used to define the type of particleboard product. **For example:** • Chipboard is made with chips, • Flake board with flakes, • Oriented strand board (OSB) with strands In the world market these panels are called chipboard or particle boards. The wood particles are bonded together by adding a synthetic adhesive and then pressing them at high pressures and temperatures. The manufacturing process and the materials/glues of these panel products has a important influence on the panel properties.
Illustration:	

8.1.4 OSB

Description:	Oriented strand board (OSB) is similar to particle board, formed by adding adhesives and then compressing layers of wood strands (flakes) in specific orientations. OSB has a rough and variegated surface with the individual strips of around 2.5 cm × 15 cm lying unevenly across each other. It produced in a variety of types and thicknesses. Normally it consists out of 3 layers and the strands are orientated. The middle layer is oriented rectangular to the face layers. OSB is a material with favourable mechanical properties that make it particularly suitable for load-bearing applications in construction. It became more popular than plywood. The most common uses are as sheathing in walls, flooring, and roof decking. For exterior wall applications, panels are available with a radiant-barrier layer laminated to one side. OSB is also used in furniture production as a base panel for lamination.
Illustration:	

OSB wood strands rotated up to 90 degrees to one another



OSB structural applications

Different OSB Standards

- **OSB type 1**: non-structural, no waterproof (furniture, interial use)
- **OSB type 2**: structural, water resistant on face (inside walls)
- **OSB type 3**: structural, for use in damp environments (covered roof/walls)
- **OSB type 4**: structural, for use in damp and outside environments (bath room, outside)

8.1.5 MDF/Fiber boards

Description:	Medium-density fibreboard (MDF) is an engineered wood product made by breaking down hardwood or softwood residuals into wood fibres. After producing the fibres, it will be combined with wax and a resin binder and formed into panels by applying high temperature and pressure. MDF is generally denser than plywood. It is made up of separated fibres but can be used as a building material similar in application to particle board. One big advantage is the homogeneous edge compared to the face. Over time, the term "MDF" has become a generic name for any dry process fibre board. The density is typically between 500 and 1,000 kg/m3. The range of density and classification as light-, standard-, or high-density board is a misnomer and confusing. The density of the board, when evaluated in relation to the density of the fibre that goes into making the panel, is important.
Illustration:	

8.2 Properties of the different boards

Material	Homogeneity	Bending strength	Water Resistance
Solid Wood	↓	**Medium**	↑**Depends on species**
Plywood	←	←	↑**Depends on glue**
Block board	←	↑	← **Depends on glue**
Chipboard	↓	←	↓**Depends on glue**
MDF	↓	↓	↓**Depends on glue**

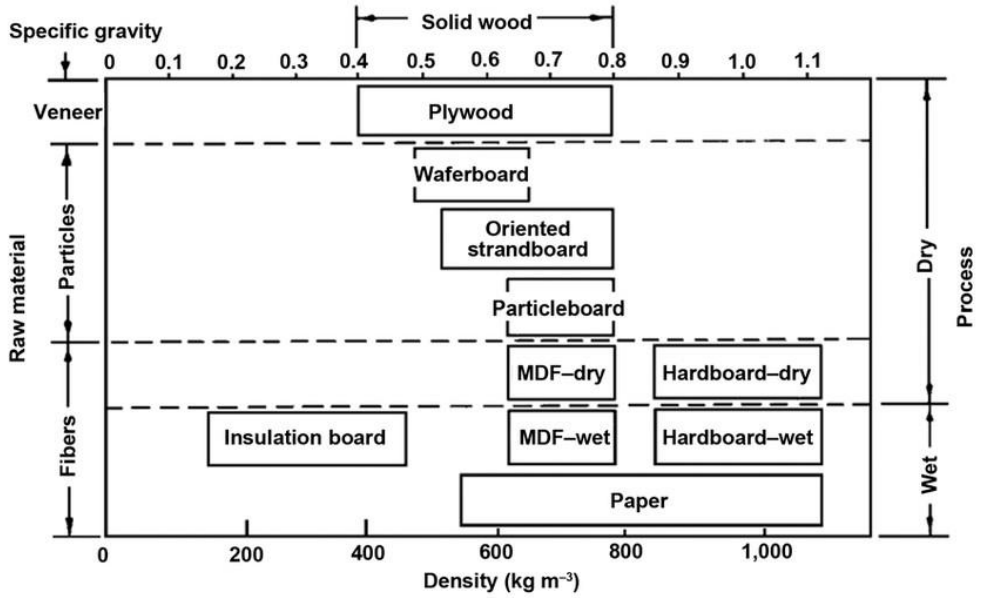
8.2.1 Dimensional stability of timber and boards.

	Direction to grain or board length		
	Parallel (%)	Perpendicular (%)	Thickness (%)
Solid Timber			
Douglas fir	negligible	2.0-2.4	2.0-2.4
Beech	negligible	2.6-5.2	2.6-5.2
Plywood			
Douglas fir	0.24	0.24	2.0
Particleboard			
UF bonded	0.33	0.33	4.7
PF bonded	0.25	0.25	3.9
MF/UF bonded	0.21	0.21	3.3
Fibre-building board			
Tempered	0.21	0.27	7-11
Standard	0.28	0.31	4-9
MDF	0.24	0.25	4-8

8.2.2 Strength properties of timber and boards

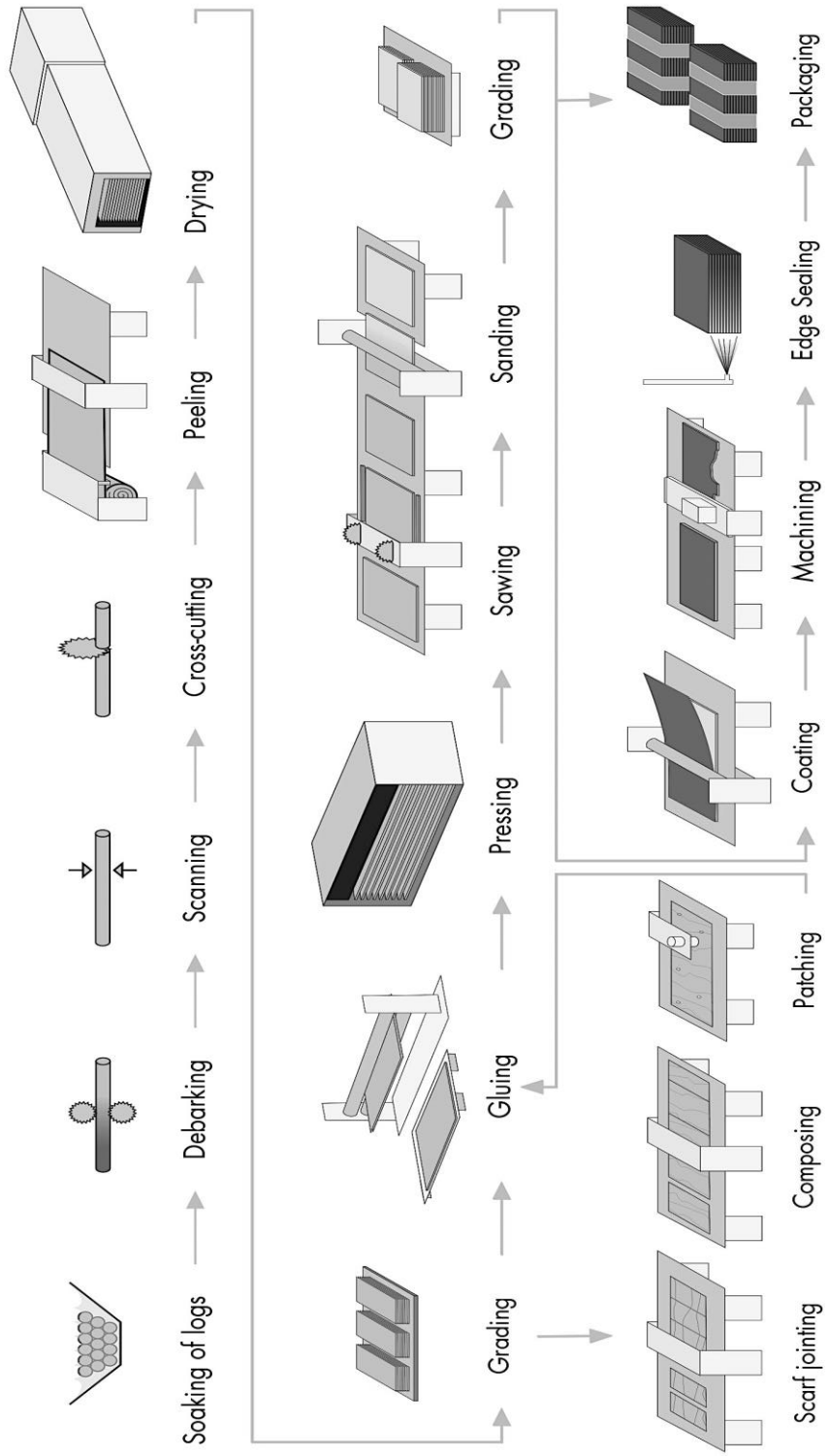
	Thickness (mm)	Density (kg/m^3)	Bending Strength (MPa)		Bending Stiffness (MPa)	
			Par.	Perp.	Par.	Perp.
Solid Timber						
Douglas fir	20	500	80	2.2	12700	800
Plywood						
Douglas fir	4.8	520	73	16	12090	890
Douglas fir	19	600	60	33	10750	3310
Chipboard						
UF bonded	18.6	720	11.5	11.5	1930	1930
PF bonded	19.2	680	18.0	18.0	2830	2830
MF/UF bonded	18.1	660	27.1	27.1	3460	3460
Fibre-building board						
Tempered	3.2	1030	69	65	4600	4600
Standard	3.2	1000	54	52	---	---
MDF	9-10	680	18.7	19.2	---	---

8.2.3 Wood based panels according to its density

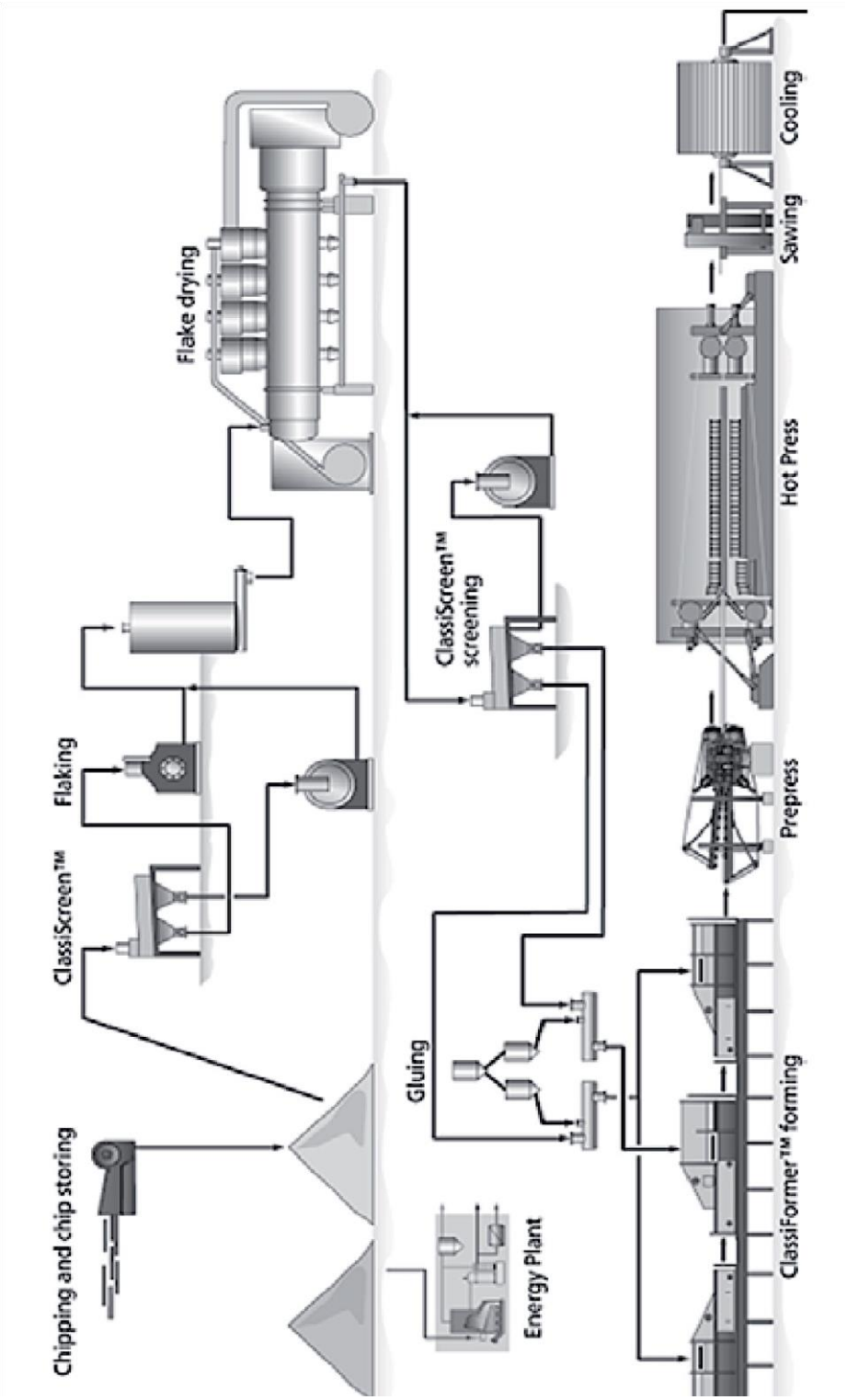


8.3 Manufacturing Process

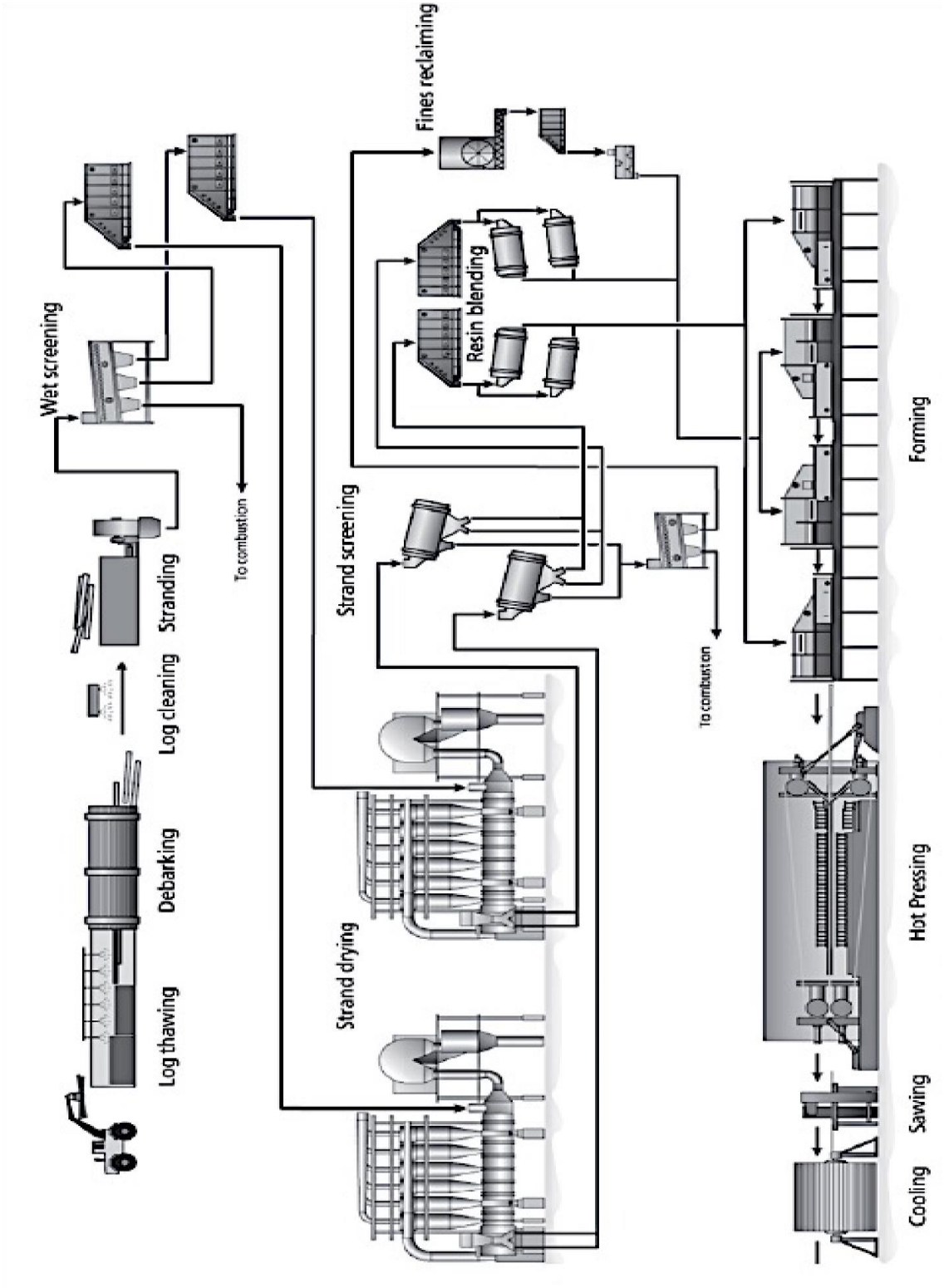
8.3.1 Plywood



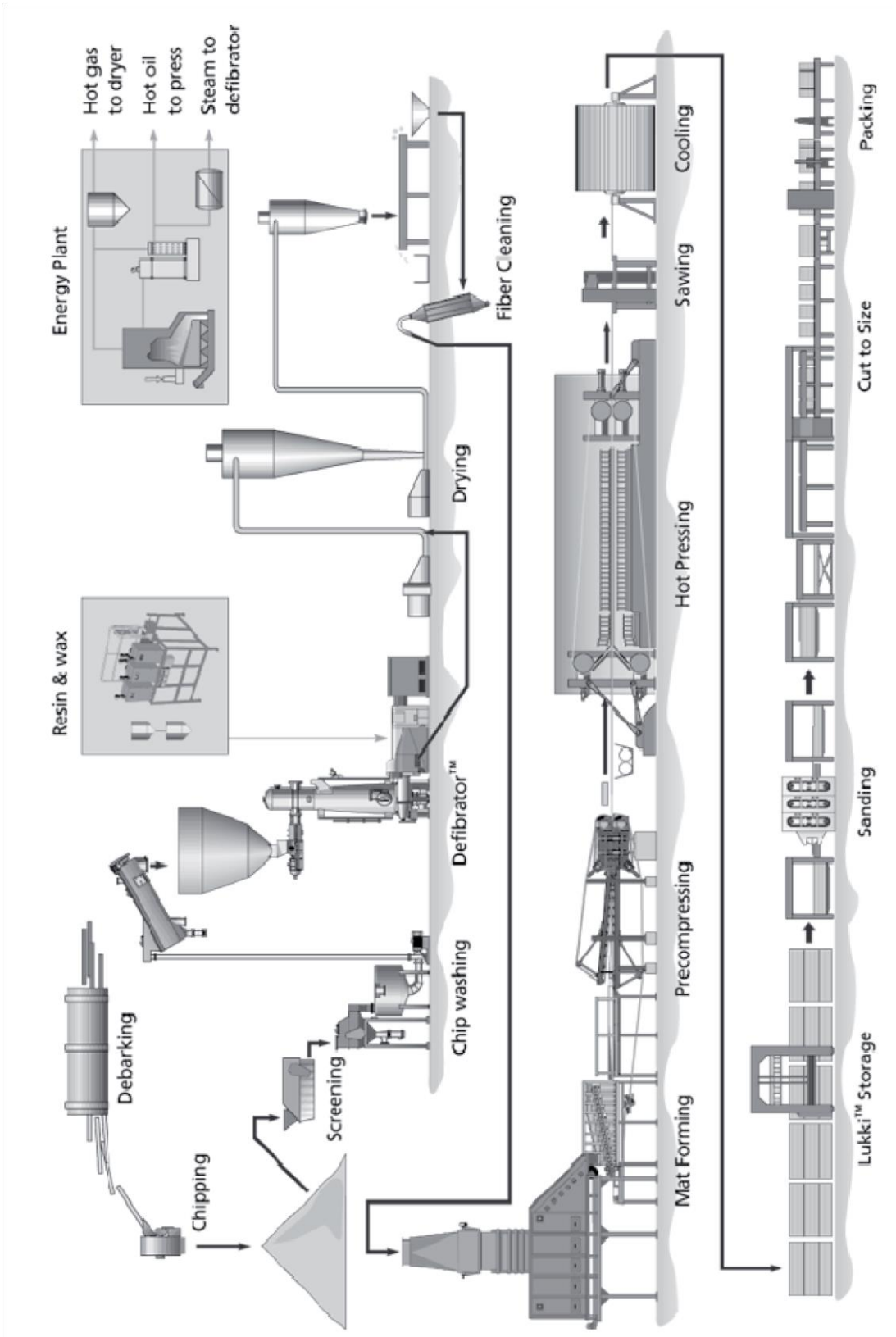
8.3.2 Particle board



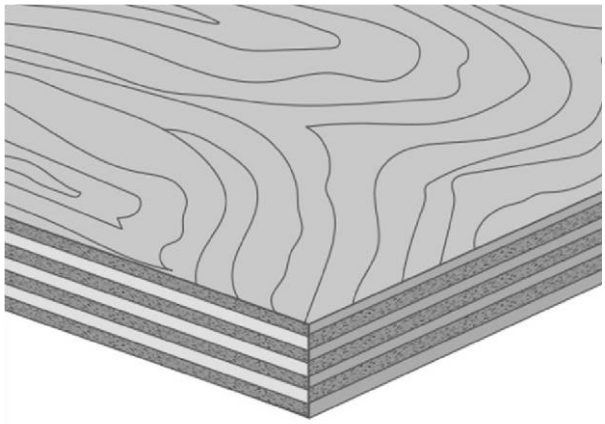
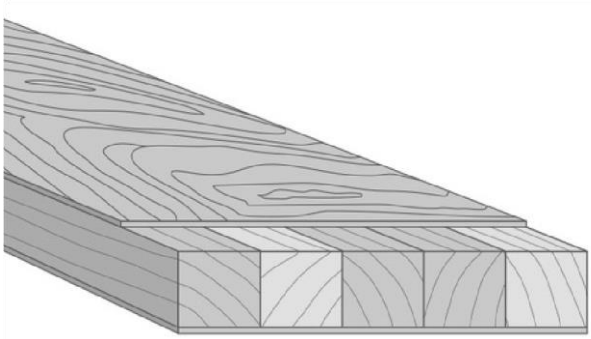
8.3.3 OSB


Fines reclaiming
Wet screening
Resin blending
To combustion
Strand screening
Forming
Stranding
Log cleaning
To combustion
Debarking
Strand drying
Hot Pressing
Log thawing
Sawing
Cooling

8.3.4 MDF board



8.4 Suitable applications for wood based panels

• Dimension stability: - (species/parallel/perpendicular - grains) • Durability: - (species) • Sizes available: 0 • Moisture resistance: -/+ (species) • Strength property: -/+ • (species/parallel/perpendicular - grains) • Application: Doors, Windows, Furniture, Roof construction, Flooring,	**Solid Wood** 
• Dimension stability: + (parallel/perpendicular) • Durability: 0/+ (glue) • Sizes available: + • Moisture resistance: 0/+ (glue) • Strength property: 0/+ (parallel/perpendicular) • Application: Furniture, Flooring, Wall…..	**Plywood** 
• Dimension stability: + (species/parallel/perpendicular - grains) • Durability: 0/+ (glue) • Sizes available: + • Moisture resistance: 0/+ (glue) • Strength property: -/+ (parallel/perpendicular) • Application: Furniture, ….	**Block board** 

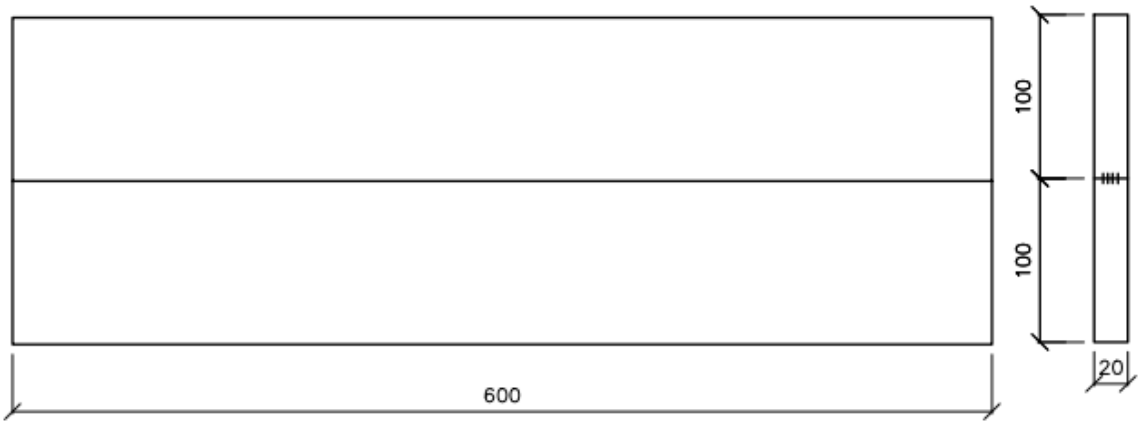
• Dimension stability: + • Durability: 0/+ (glue) • Sizes available: + • Moisture resistance: 0(glue) • Strength property: 0 (parallel/perpendicular) • Application: Furniture, …..	**Chip Board** 
• Dimension stability: + • Durability: 0/+ (glue) • Sizes available: + • Moisture resistance: 0/+ (glue) • Strength property: 0/+ (parallel/perpendicular) • Application: Ceiling, Walls, roof construction	**OSB Oriented Strand Board** 
• Dimension stability: + • Durability: 0 (glue) • Sizes available: + • Moisture resistance: 0(glue) • Strength property: -/0 (parallel/perpendicular) • Application: Furniture, ….	**Fibre Board** (MDF – Middle Density Fibre Board) 

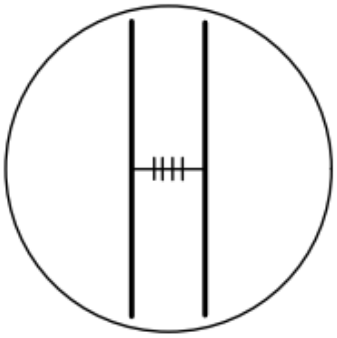
EXERCISES

Practical Exercises	Chapter	Priority
1. Edge to Edge - Butt Joint	2	Optional
2. Edge to Edge - Dowel Joint -	2	✓
3. Mortise and Tenon	3	✓
4. Mitred Corner Bridle Joint	3	Optional
5. Rabbet Mortise and Tenon	3	Optional
6. T- Mortise and Tenon	3	✓
7. Cross Halving Joint	3	✓
8. Dovetail Join	4	✓
9. Cabinet Corner Joints		✓
10. Cabinet Corner Joints - Drawers		✓

Additional Practical Exercises	Chapter	Priority
1. Edge to Edge - Butt Joint		Optional
2. Edge to Edge - Dowel Joint -		Optional

➢ Exercise Edge to Edge Joint – Butt Joint

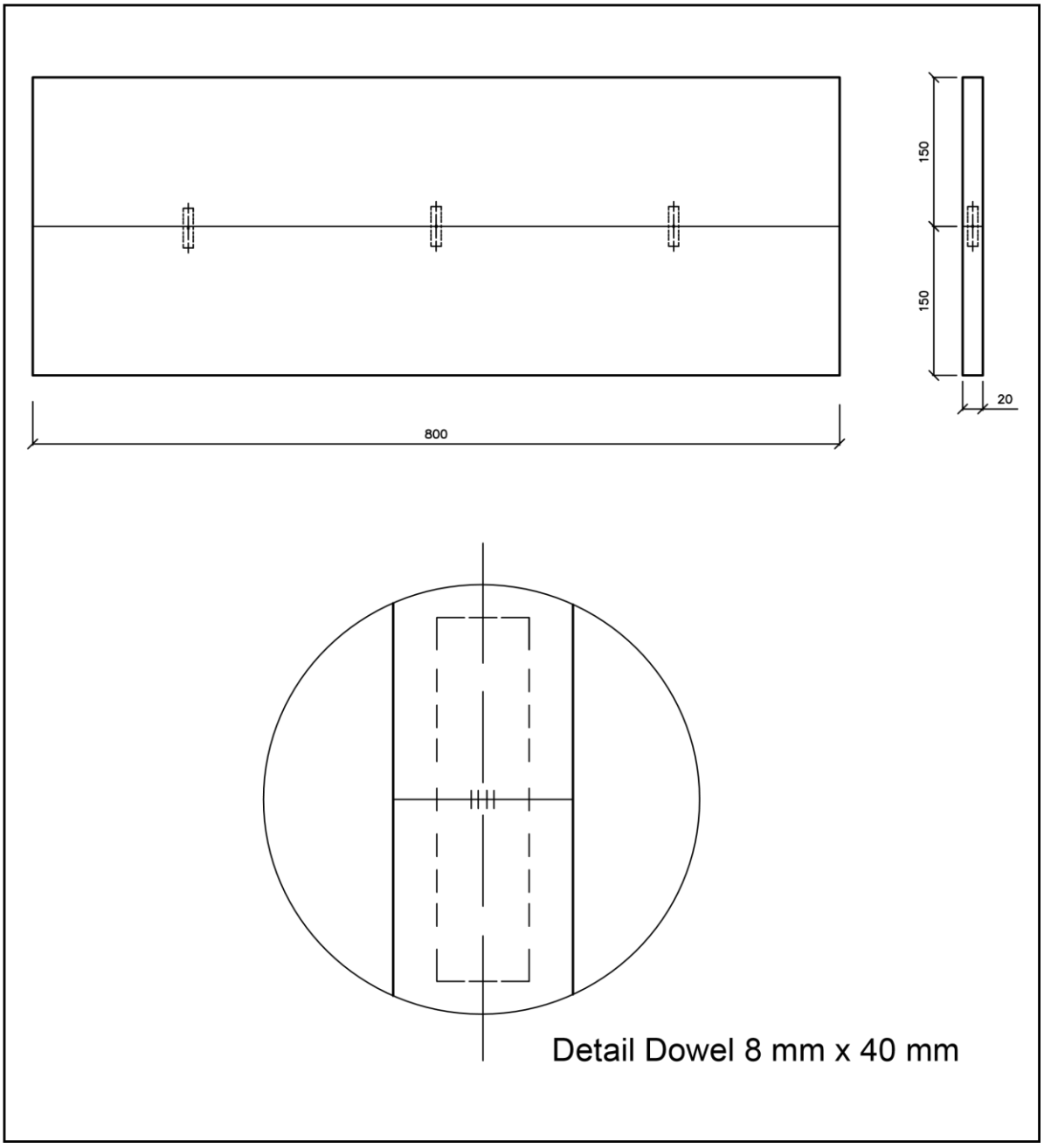




Detail

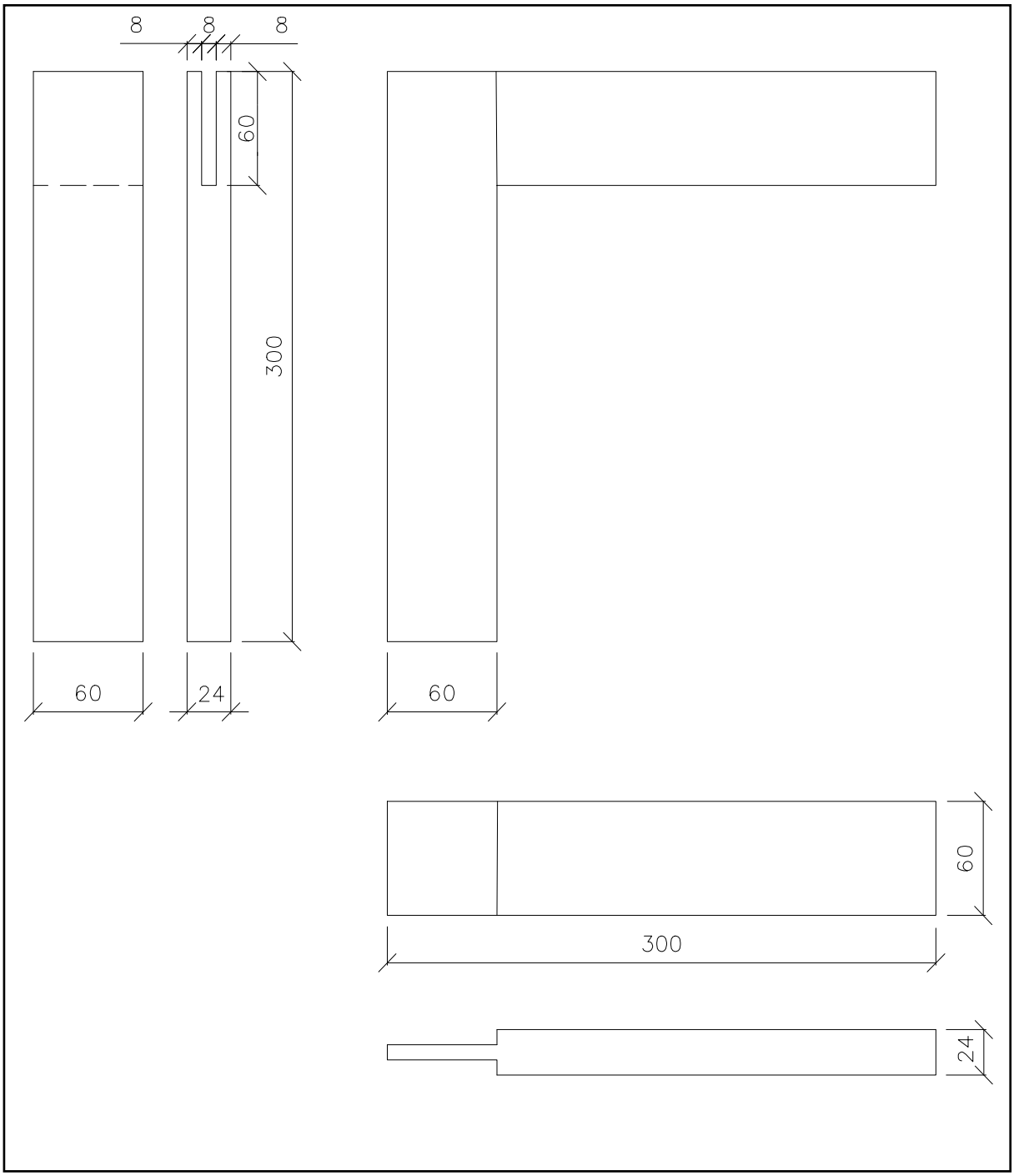
BOM– All Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	Length	Width	Thick.	Qty	Length	Width	Thick.
1	Boards	1	1220	110	20	2	600	100	20

➢ Exercise Edge to Edge Joint – Dowel Butt Joint



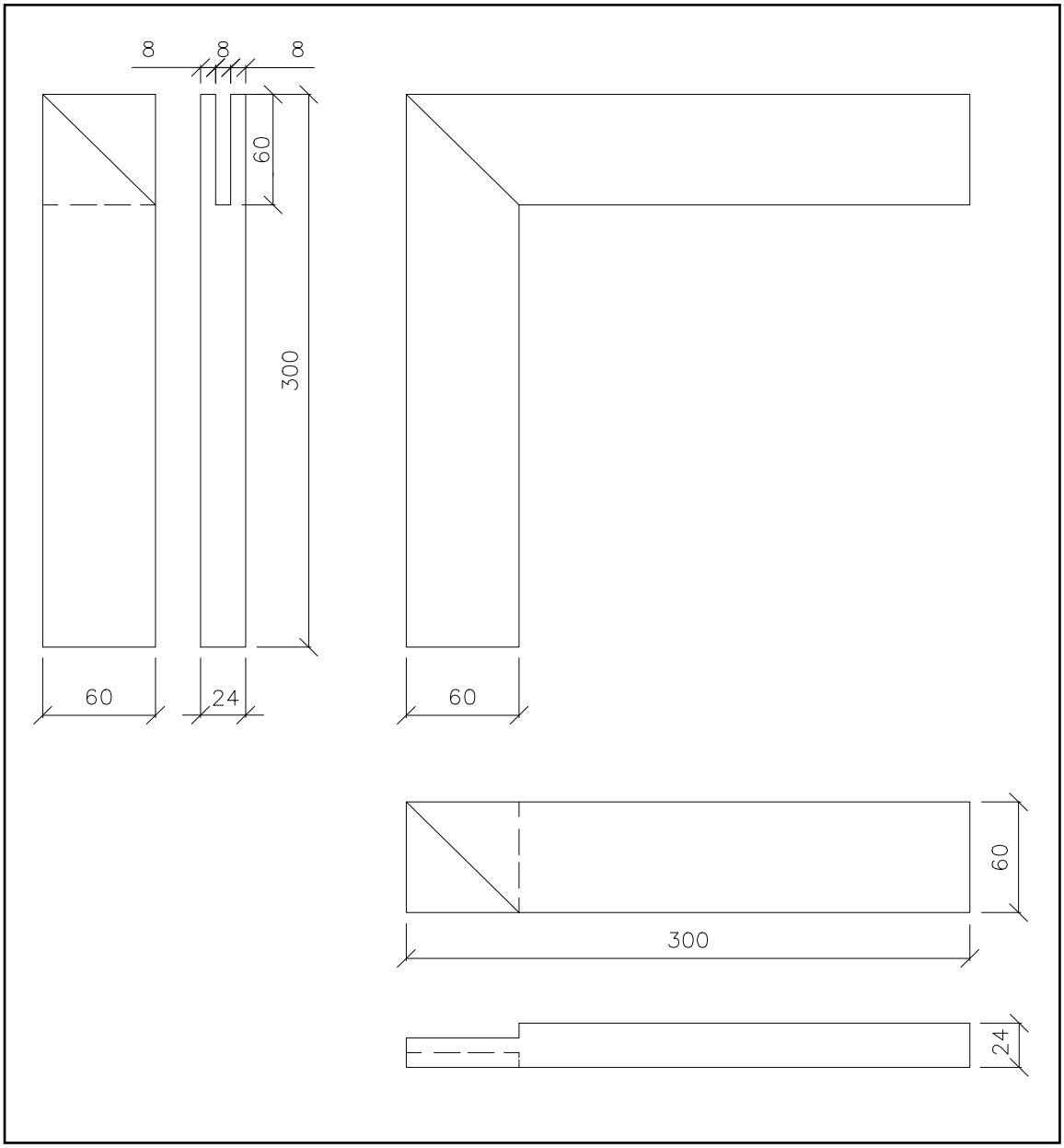
BOM– all Dimensions in mm			Rough Dimensions						
	Part		length	width				width	
	Boards		1220	110			600	100	20

➢ Exercise Mortise and Tenon Joint



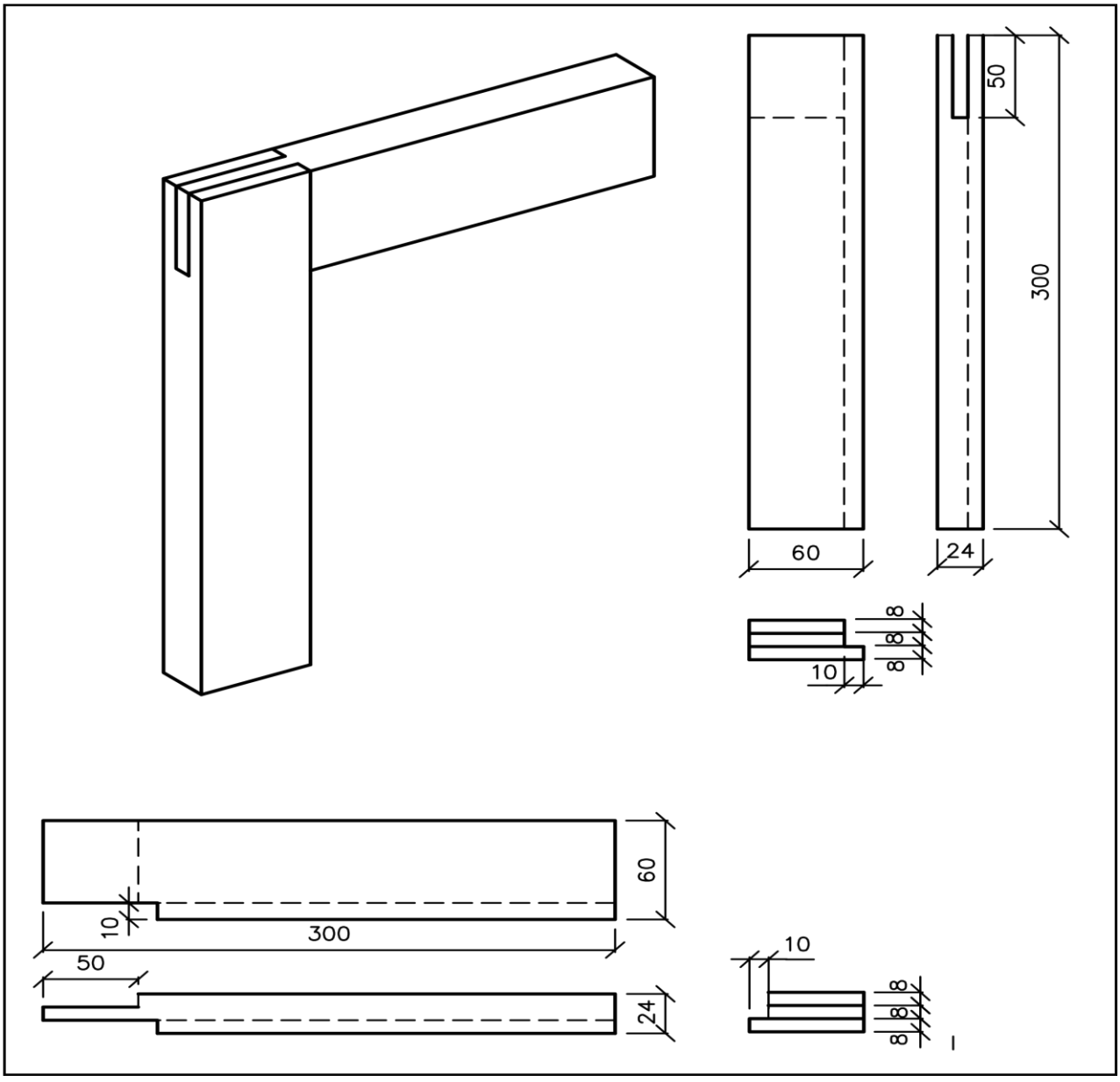
0BOM – all Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	length	width	thick.	Qty	length	width	thick.
1	Frame	1	610	70	24	2	300	60	24

➢ Exercise Mitre Corner Bridle Joint



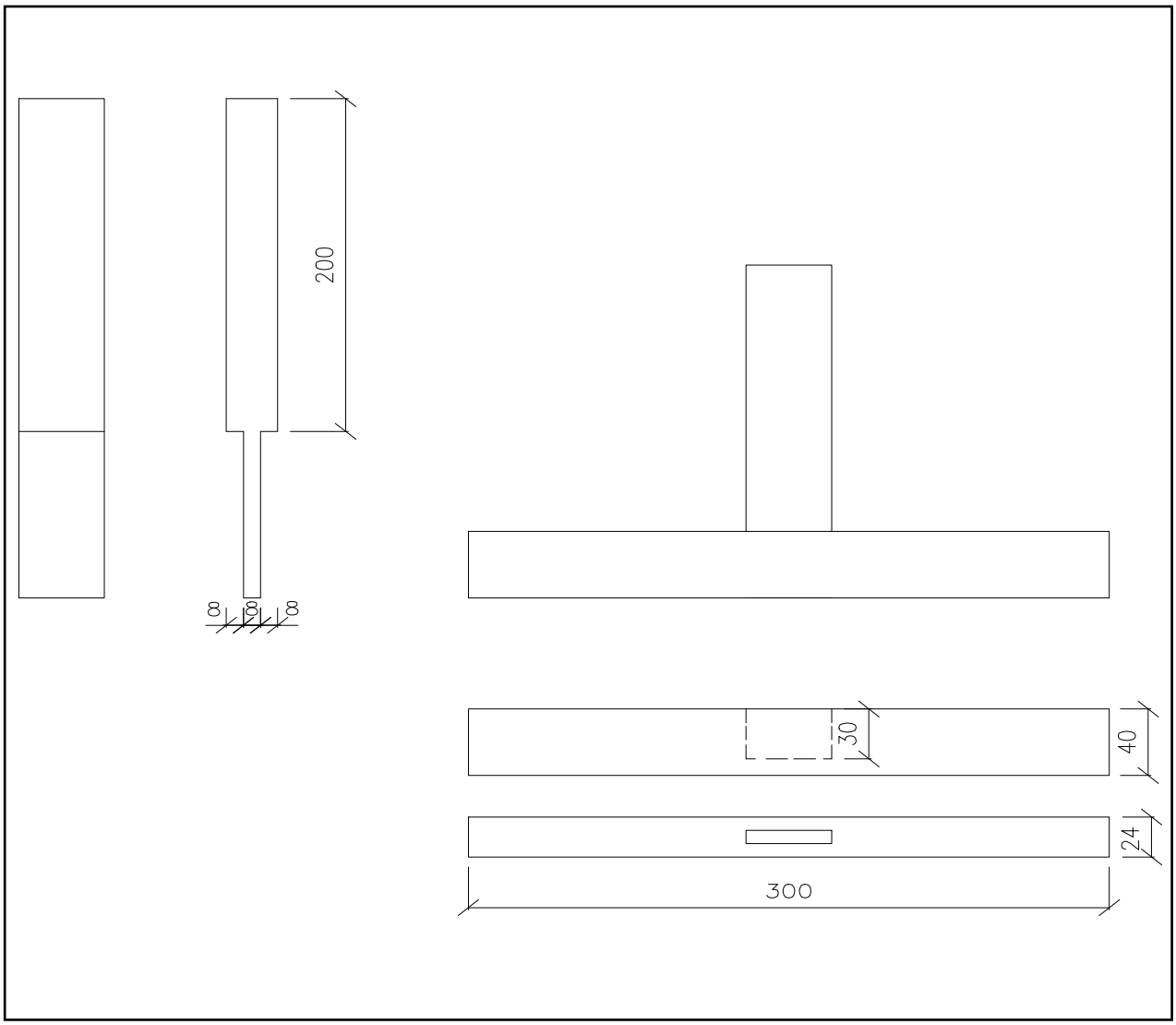
BOM – all Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	length	width	thick.	Qty	length	width	thick.
1	Frampieces	1	610	70	24	2	300	60	24

➢ Exercise - Rabbet Mortise and Tenon Joint



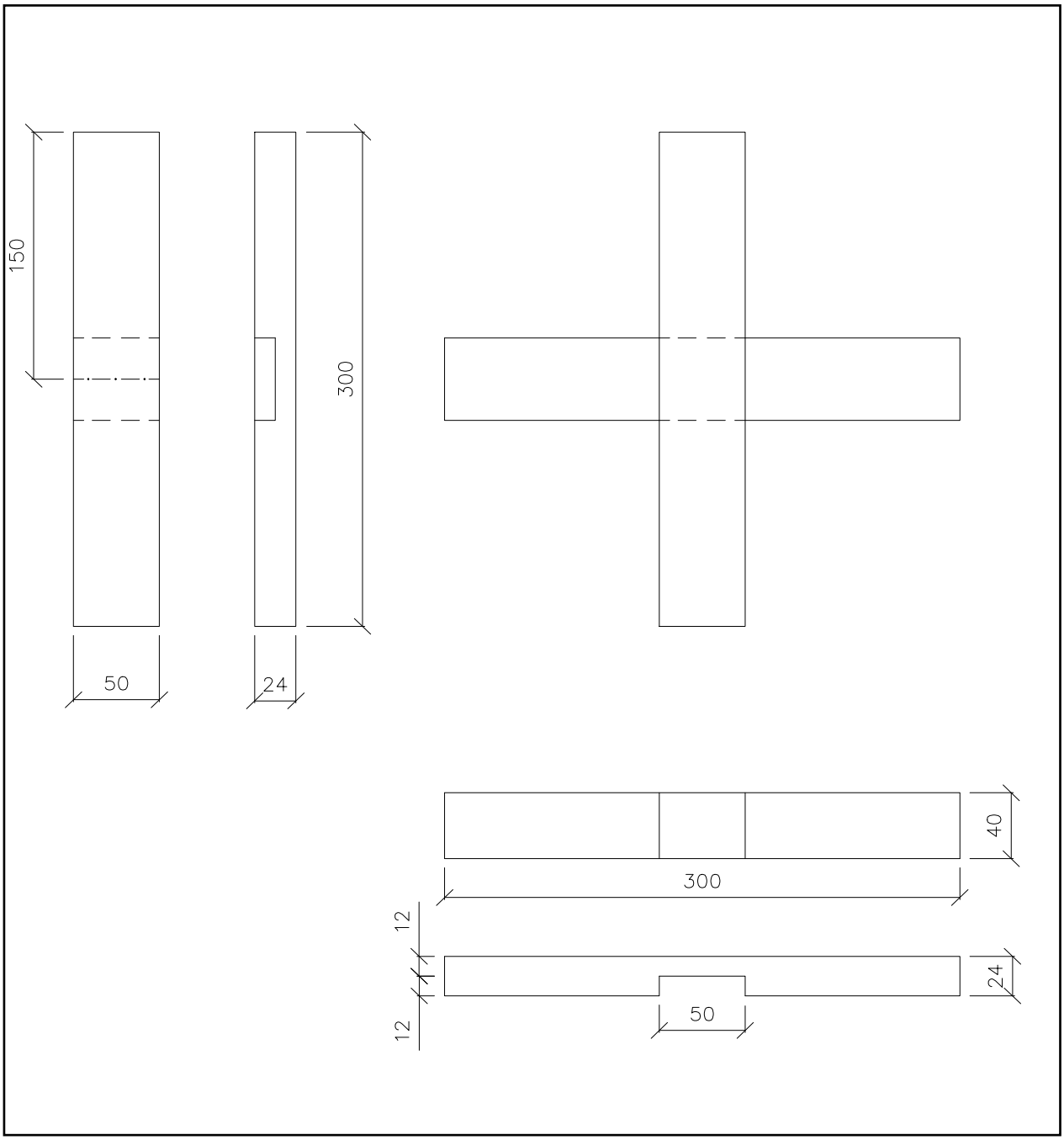
BOM – all Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	length	width	thick.	Qty	length	width	thick.
1	Framepieces	1	610	60	24	2	300	60	24

➢ Exercise T-Stopped Mortise and Tenon



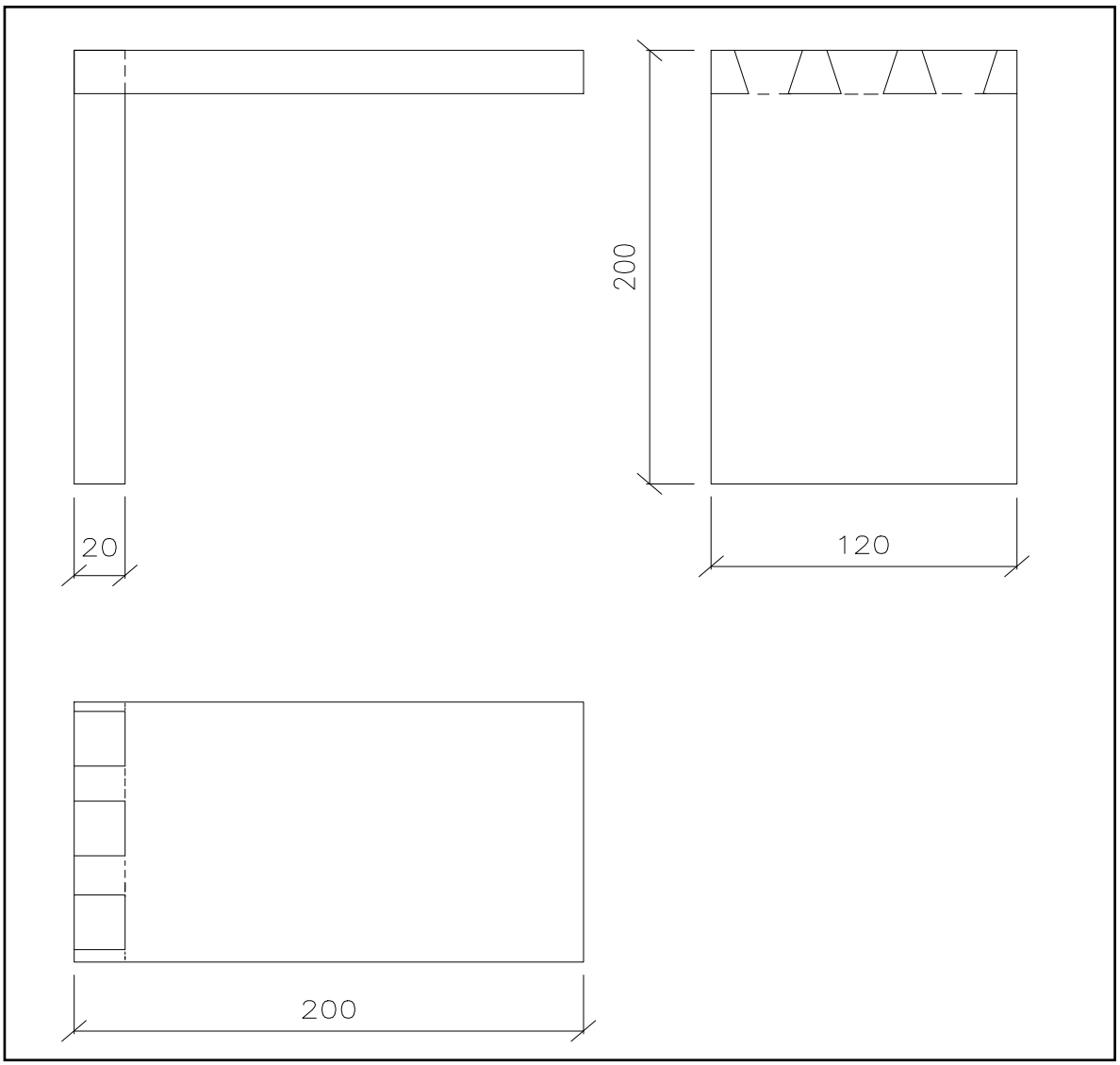
BOM – all Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	length	width	thick.	Qty	length	width	thick.
1	Frampieces	1	610	70	24	2	300	60	24

➢ Exercise - Cross Halving Joint



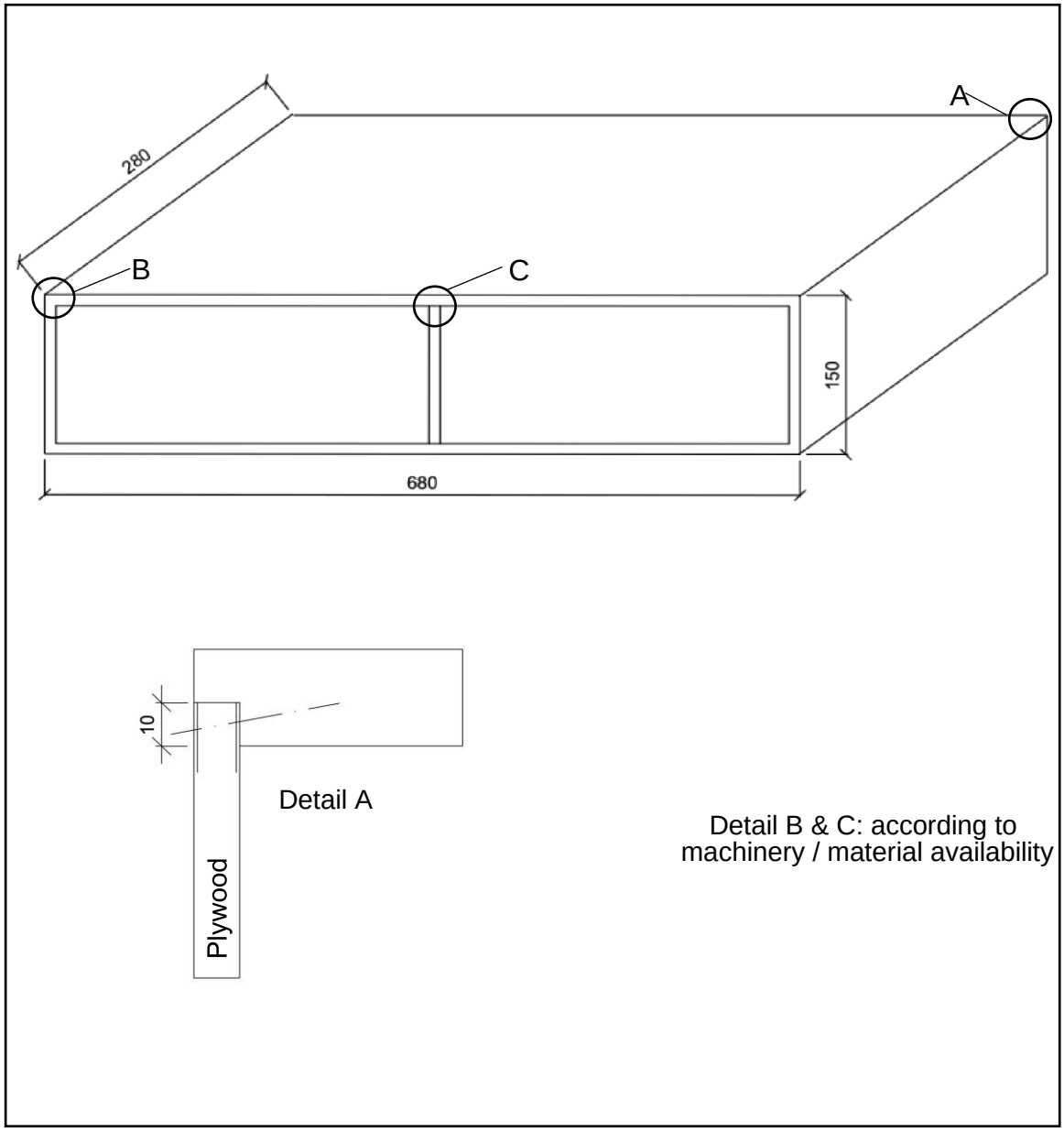
BOM – all Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	length	width	thick.	Qty	length	width	thick.
1	Frampieces	1	610	60	24	2	300	50	24

➢ Exercise Dovetail Joint



BOM – all Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	length	width	thick.	Qty	length	width	thick.
1	Sides	1	410	130	20	2	200	120	20

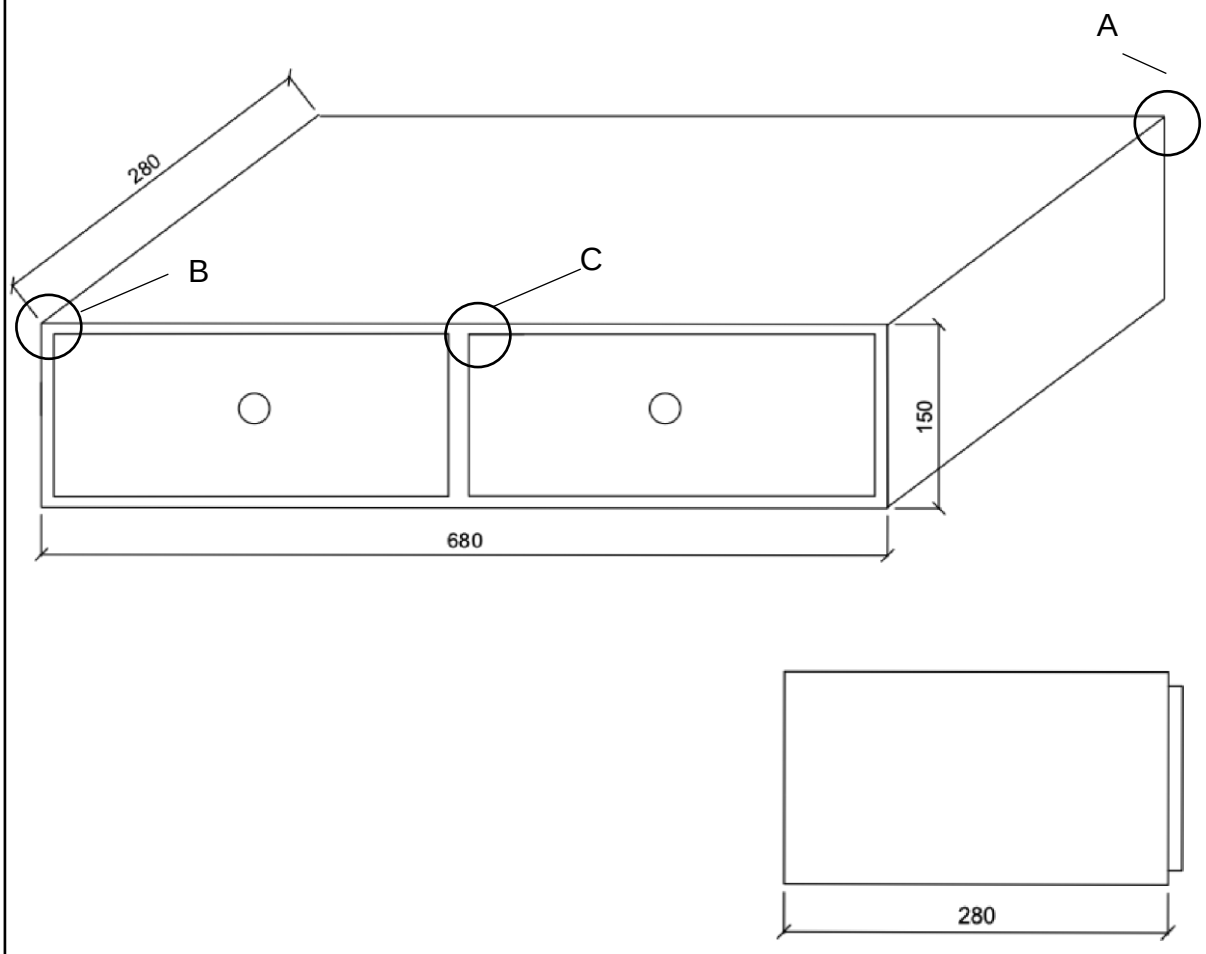
➢ Cabinet Corner Joints



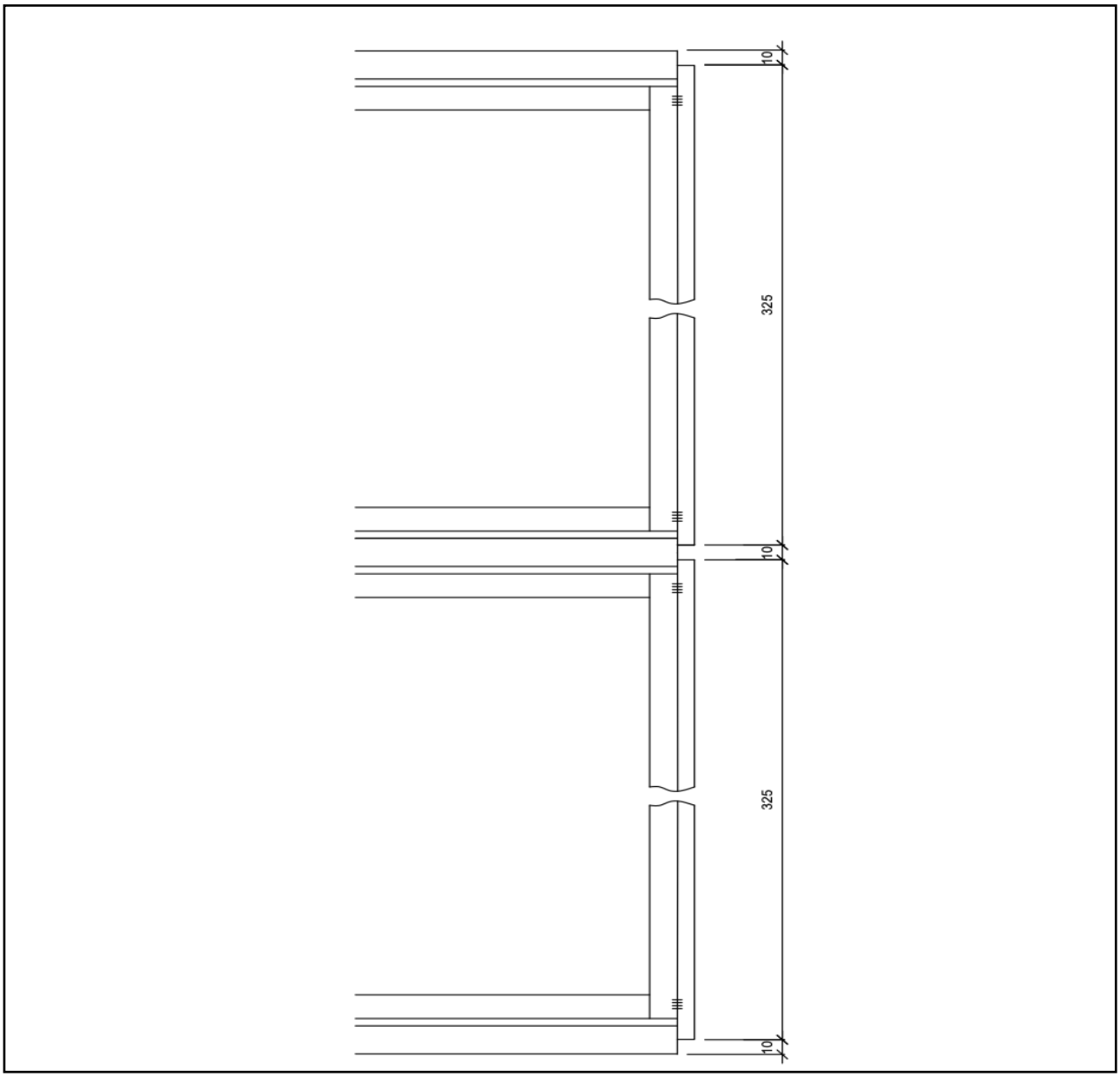
BOM – all Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	length	width	thick.	Qty	length	width	thick.
1									

➢ Drawer Construction

Selectsuitable joints according to the



BOM – all Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	length	width	thick.	Qty	length	width	thick.



BOM – all Dimensions in mm		Rough Dimensions				Finished Dimensions			
Pos.	Part	Qty	length	width	thick.	Qty	length	width	thick.

REFERENCE MATERIAL

Evaluation: Criteria

	Level of competence			
Work Step	**Beginning**	**Developing**	**Achieving**	**Excelling**
Measurement	No attention to measurements. Very little accuracy in following plans.	A few measurement errors. Plans not followed closely. Many steps done incorrectly.	Minor measurement errors. Plans followed but some steps skipped or done incorrectly.	Measurements are accurate. Plans followed.
Cuts / Joints	Cuts not square, joints do not fit tightly. Joints are not flush.	Joints fit tightly. Joints are not flush.	Some minor errors in cuts or joint fit.	Cuts accurate. Joints fit tightly.
Assembly	Little care taken in assembly of project. Some pieces do not fit correctly. Abundance of glue. No fasteners or an abundance of bent fasteners. Holes where nails have been pulled.	Minor errors in assembly. Overall assembly is accurate. Minor evidence of glue. One or 2 bent fasteners. Fasteners not driven flush. One or two holes where nails or screws have been removed.	No visible errors in assembly. No visible glue. Fasteners visible but are flush and not bent.	No visible errors in assembly. No visible glue. No visible fasteners.
Sanding	Large scratches or gouges in wood surface. Sanding across grain is obvious. Not sanded to the proper grit paper.	Some large scratches are visible. Some cross grain sanding may be visible.	Smooth finish. Some cross grain sanding may be visible.	Smooth finish with no visible scratches.
Finish	Stain/Paint is blotchy or incomplete. Finish does not cover all of the wood or has visible brush marks and bubbles. Glue is visible under finish.	Stain/Paint is not consistent throughout the project. Finish has minor imperfections. Glue is visible under finish.	Stain/Paint is even. Finish is even with only the smallest of imperfections noticeable.	Stain/Paint is even. Finish is even with no noticeable imperfections.
Safety	Participant neglects to use proper safety equipment and is careless in the work. Does not keep area neat and organized.	With prompting, participant uses safety glasses and ear protection. participant is somewhat careless about work and does not keep area neat.	Participant usually uses safety glasses/ear protection, works carefully and keeps work area neat and clutter free.	Participant always uses safety glasses/ear protection, works carefully and keeps work area neat and clutter free
Craftsmanship	Project has many errors. participant did not apply given talent.	Project has few minor errors. participant applied given talent to satisfactory standards.	Project built to quality standards. Not able to be sold in a store.	Project built to detailed standards. Able to be sold in a store.
Clean Up	Participant never cleaned.	Participant did attempt to clean area.	Participant picked up after themselves, but it was not perfect.	Participant would not leave room till his her area was spotless.

Evaluation:

	Level of competence				
Project					
Name					
Work Step	**Beginning**	**Developing**	**Achieving**	**Excelling**	
Measurement					
Cuts / Joints					
Assembly					
Sanding					
Finish					
Safety					
Craftsmanship					
Clean Up					
Total					

APPENDIX

Appendix 1

The following information on Safe Working Practise contains public sector information published by the Health and Safety Executive and licensed under the Open Government Licence of UK.

Appendix 1	⚠ Circular Saw ⚠ Vertical spindle moulding machines ⚠ Hand-fed surface planing machine ⚠ Wood turning lathes ⚠ Narrow band saws ⚠ Cross-cut sawing machines ⚠ Tooling hand-fed woodworking machines ⚠ Single-end Tenoning machines

Circular saw benches – Safe working practices

HSE information sheet

Introduction

This information sheet is one of a series produced by HSE's manufacturing sector. It gives practical guidance on safe working practices at circular saw benches.

When buying a new circular saw bench, it should be supplied with a declaration of conformity and have a CE Mark. It should be designed and constructed to meet BS EN 1870–1:2007 + A1:2009.[1] New saw blades should meet BS EN 847–1:2005.[2]

Accident history

Circular saw benches are the machines that cause the most woodworking accidents. Many of these result in the amputation of fingers. Analysis of accidents investigated by HSE has found that most were caused by inadequate or missing guards. Many of these accidents could have been avoided by having a correctly adjusted saw guard and using a push-stick. Inadequate or lack of training for the operator was also found to be a major cause. It is therefore very important that only properly trained and authorised operators are allowed to use circular saws. Kickback of the work piece has caused serious and even fatal accidents.

General safety issues

Risk assessment

A risk assessment[3] should be carried out covering all foreseeable uses and operations at the circular saw bench. It should identify the action needed to eliminate or control risks. As part of the assessment you should consider if there is a more suitable machine for the process or operation. For example, a properly guarded vertical spindle moulder or router are most suitable for grooving work.

Riving knife and saw guard

Suitable top guards and riving knives should be fitted to all circular saw benches. It is vital that these are properly adjusted for each job being carried out.

Machines should be fully enclosed beneath the table.

Braking

To reduce the risk of contact with the saw blade during run down, machines should be fitted with a braking device that brings the blade to rest within 10 seconds. Unless already fitted with a manual or foot operated brake, circular saw benches with a rundown time greater than 10 seconds should have been fitted with a braking device by 5 December 2003.[4,5]

Saw blades

Dull, badly set and badly ground saw blades produce poor quality work. They also increase the effort required for feeding and the risk of accidents from kickback. Deposits of gum or resin near the teeth tend to cause a saw to stall or the timber to stick.

Never try to clean a running blade: stop the saw, remove the blade and use a suitable scraper to remove the resin.

Saw blade diameter

The diameter of the smallest saw blade that can be safely used should be marked on the machine. A small diameter blade (i.e. less than 60% of the diameter of the largest blade the saw can accommodate) will have a low peripheral blade speed and will cut inefficiently and increase the risk of kickback.

Wood dust

Saw benches should be fitted with effective local exhaust ventilation both above and below the table to control wood dust[6] (see Figure 1).

Work piece support

Adequate work piece support is essential for all operations at a circular saw bench. Large work pieces Work piece support Adequate work piece support is essential for all operations at a circular saw bench. Large work pieces should be supported using extension tables or roller supports at both the infeed and outfeed ends. If there is a second operator at the outfeed end to remove cut pieces, the table should be extended so the distance between the saw blade spindle and the rear edge of the table is at least 1200 mm. The second operator should always remain at the outfeed end of the extension and should not reach forward towards the saw. Although the riving knife reduces the risk of contact, it cannot prevent it.

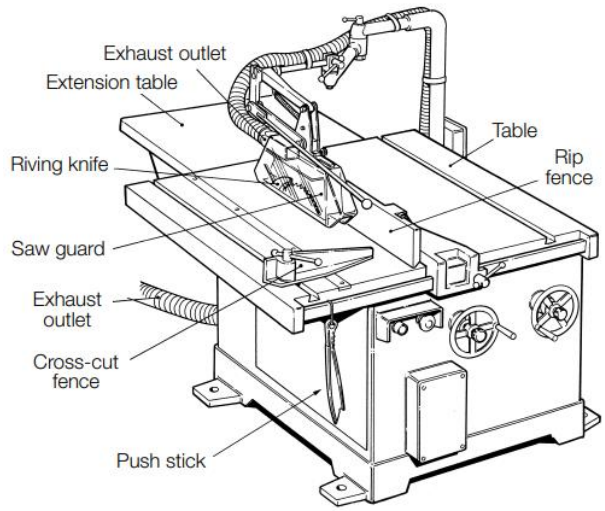


Figure 1 Circular saw

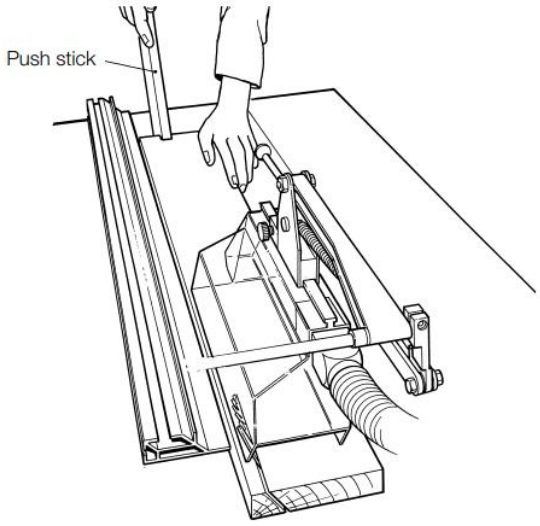


Figure 2(b) Low position fence for shallow or angled ripping

A rip fence or a cross-cut fence should be used to give adequate workpiece support during cutting (see Figure 2(a)). To prevent kickback, the front of the fence must be set no further than the base of the saw blade gullet at table level. When cutting shallow or angled work, the normal fence may need to be replaced with a low fence to aid the use of a push-stick and to prevent the canted saw blade touching the fence (see Figure 2(b)). Timber with a round cross-section should not be cut on a bench saw unless the workpiece is adequately supported and held in position by a gripping device.

Use of a push-stick

A push-stick should always be used when making any cut less than 300 mm in length or

when feeding the last 300 mm of a longer cut. Push-sticks should be at least 450 mm long with a 'bird's mouth' (see Figure 3). The leading hand should never be closer than is necessary to the front of the saw and hands should never be in line with the saw blade. A push-stick should always be used to remove the cut piece from between the saw blade and fence, unless the width of the cut piece exceeds 150 mm.

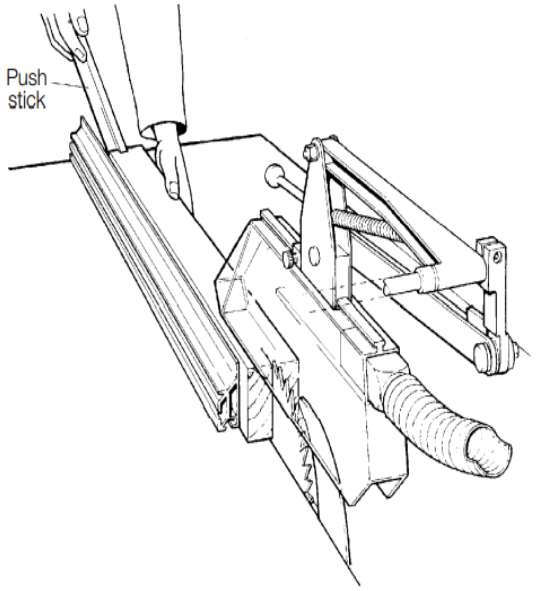


Figure 2(a) Normal fence position for ripping

Figure 3 Push stick

Use of power feed

Use a demountable power feed whenever practicable to do so. This reduces the risk of contact with the saw blade (see Figure 4). A demountable power feed unit is not a substitute for a riving knife. The riving knife should be kept in position whenever a demountable power feed is used.

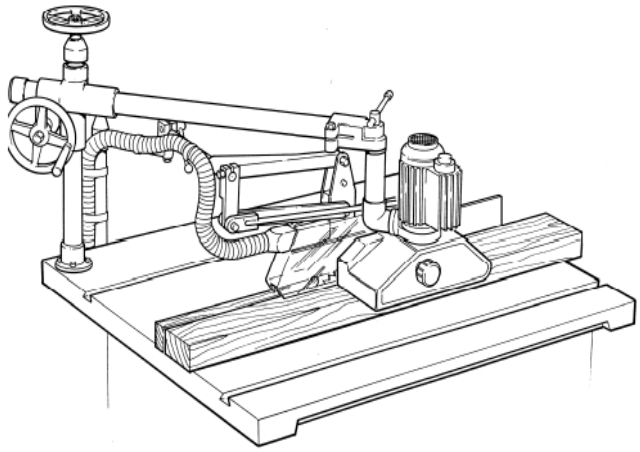


Figure 4 Using a demountable power feed

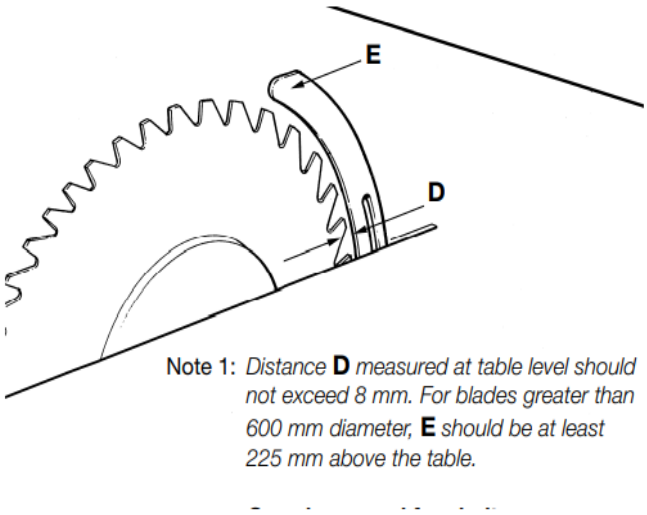


Figure 6 Riving knife fixing

Ripping and cross-cutting

Safe ripping and cross-cutting relies on:

- adequate workpiece support;
- correct positioning of the hands;

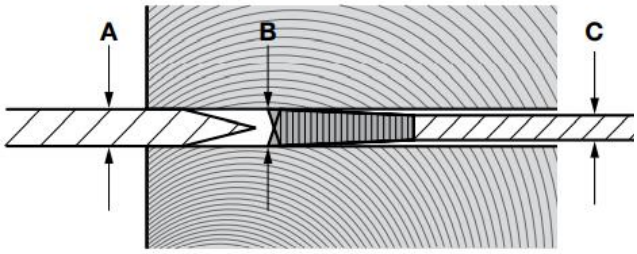
■ appropriate use of a push-stick;

■ the correct adjustment of the riving knife and saw guard.

Riving knives should:

■ have a chamfered leading edge;

■ be thicker than the body of the saw blade, but slightly thinner than the width of cut (see Figure 5);



Key: **A** *is riving knife thickness*
B *is kerf of saw (width of cut)*
C *is thickness of saw blade body*

A *to be greater than* **C**, *but less than* **B**

Figure 5 Thickness of riving knife in relation to the saw blade

■ be rigid and set accurately in line with the saw;

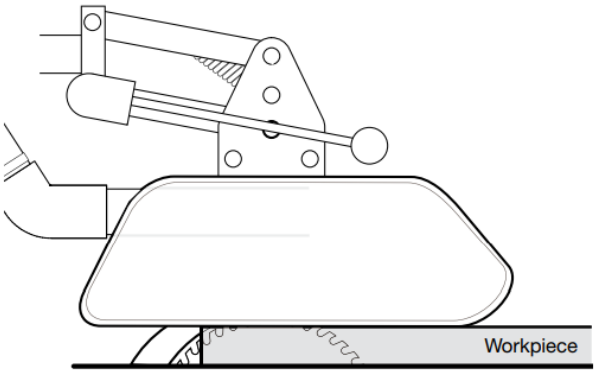
■ shaped so the inner edge follows as closely as practicable the contours of the largest saw blade designed to be used on the machine (see Figure 6).

Saw guards should:

■ be strong and easily adjustable;

■ be large enough and shaped so as to enclose as much of the blade as is practicable during the cutting operation;

■ be kept adjusted as close as possible to the surface of the workpiece (see Figure 7).



Note: *The saw guard must be adjusted as close to the workpiece as possible*

Figure 7 Setting of the saw guard

Saw blades should:

■ be set so that the teeth project through the surface of the material during cutting;

■ not, however, be set higher than necessary;

■ be suitable for the work, i.e. when cross-cutting on a circular saw bench the ripping blade should be replaced with either a cross-cut or combination blade.

Rebating and grooving

A circular saw should not be used for cutting a rebate or groove unless the blade is effectively guarded. This is because the normal saw guard cannot be used. Suitable alternative guards and fixtures are necessary. Figure 8 shows an example of one method for rebating or grooving using Shaw guards. Where practicable, the tunnel formed by the pressure pads should be designed to meet the requirements of BS EN ISO 13857:2008.

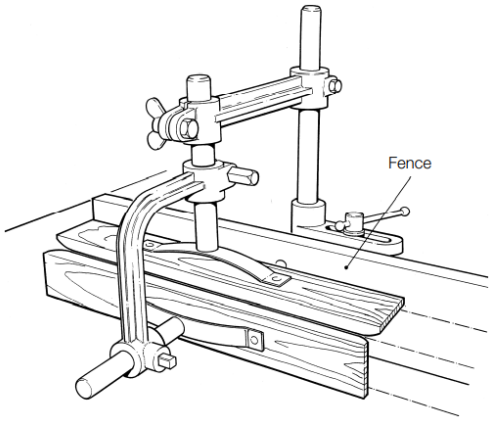


Figure 8 Saw guard for rebating and grooving on a saw bench

Stopped grooving should not be done on a circular sawing machine. This should be done on a vertical spindle moulding machine or a hand/pin routing machine.

Angled cutting and bevelling Angled cuts can be made on a tilting arbour saw by inclining the saw blade to the required angle and feeding the workpiece as for ripping or cross-cutting. The saw guard must be suitable for this operation and be designed so that it prevents the risk of contact with the inclined blade. The fence should be set in its low position or an auxiliary fence used to prevent the possibility of the fence touching the rotating saw blade. On machines with a fixed position spindle, a simple jig may be constructed to give adequate workpiece support during the cutting operation (see Figures 9(a) and 9(b)).

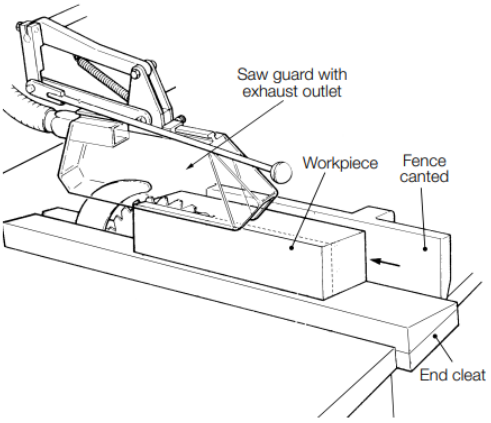


Figure 9(a) Bevel ripping

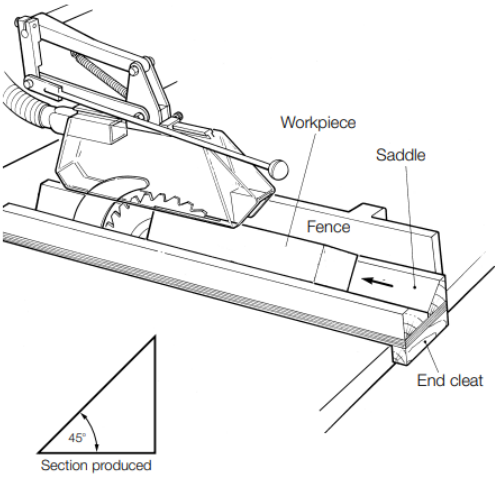


Figure 9(b) Angle ripping

References

1 BS EN 1870–1:2007 + A1:2009 *Safety of woodworking machines. Circular sawing machines. Circular saw benches (with and without sliding table), dimension saws and building site saws* British Standards Institution

2 BS EN 847–1:2005 *Tools for woodworking. Safety requirements. Milling tools, circular saw blades* British Standards Institution

3 *Management of health and safety at work. Management of Health and Safety at Work Regulations 1999. Approved Code of Practice and guidance* L21 (Second edition) HSE Books 2000 ISBN 978 0 7176 2488 1 www.hse.g.ov.uk/pubns/priced/l21.pdf

4 *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 as applied to woodworking machinery. Approved Code of Practice and guidance* L114 HSE Books 1998 ISBN 978 0 7176 1630 5

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5 *PUWER 98: Retrofitting of braking to woodworking machines* Woodworking Information Sheet WIS38 HSE Books 1998 www.hse.g.ov.uk/pubns/woodindx.htm

6 LEV: *General principles of system design* Woodworking Information Sheet WIS23 HSE Books
1992 www.hse.g.ov.uk/pubns/woodindx.htm
(A revised version of WIS23 is due to be published in 2012 as *Wood dust and how to control it*)

7 BS EN ISO 13857:2008 *Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs* British Standards
Institution

Further reading

Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of
Practice and guidance L22 (Third edition) HSE Books 2008 ISBN 978 0 7176 6295 1 www.hse.g.ov.uk/pubns/books/l22.htm

While every effort has been made to ensure the accuracy of the references listed in this publication, their future availability cannot be guaranteed.

Further information

More information on circular saws, including videos illustrating correct working practices and a circular sawing machines poster, can be found on HSE's woodworking

website: www.hse.g.ov.uk/woodworking.htm.

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit www.hse.g.ov.uk/. You can view HSE guidance online and order priced publications from the website. HSE priced publications are also available from bookshops.

British Standards can be obtained in PDF or hard copy formats from BSI: http://shop.bsigroup.com or by contacting BSI Customer Services for hard copies only Tel: 020 8996 9001 email: cservices@bsigroup.com.

This information sheet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

This document is available at: www.hse.g.ov.uk/pubns/wis16.pdf.

Vertical spindle moulding machines

Safe working practices
HSE information sheet

Introduction

This information sheet gives practical guidance on safe working practices when using a vertical spindle moulding machine for straight, stopped and curved work. This information is aimed at employers and others who have control of how these machines are used. Machine operators will also find this information of use.

Accident history

Vertical spindle moulding machines have a history of serious accidents that frequently involved the loss of several fingers. Although the severity of injuries has reduced since the requirement to use chip limited tooling was introduced, they remain a common cause of accidents in the woodworking industry. Accidents are caused:

- By cutters snatching;
- From work piece kick-back;
- During straight work by not using a false fence and pressure pads (Shaw guards) to adequately enclose the cutters;
- During stopped and curved work by not using backstops, jigs or work piece holders.

Training issues

It is important that the machines are fitted with the necessary safeguards and operators are trained to use them and carry out the work safely.[1] Training is particularly important for those involved in maintenance, setting and cleaning to ensure that these activities are undertaken in a safe manner.

No one should be allowed to work on a vertical spindle moulding machine unless they have demonstrated competence. It is advisable that competent operators are authorised in writing by a responsible person (director, senior manager etc.). This will then form part of the training records. Anyone who supervises the use of any work equipment should have access to information and where appropriate, written instructions.[1]

Legal requirements

Legal requirements covering the use of these machines are contained in *Safe use of woodworking machinery Provision and Use of Work Equipment Regulations 1998 (as applied to woodworking*

machinery). Approved Code of Practice and guidance.[1]

This document gives practical advice on the provision of information and training as well as aspects of guarding and maintenance.

When buying a new vertical spindle moulder, it should be supplied with a declaration of conformity and have a CE Mark. Designers and manufacturers must conform to the essential

safety requirements of the Machinery Directive and associated European Free Trade Association (EFTA) Regulations. One way of achieving this is by designing and constructing the machine to meet BS EN 848-1.[2] Cutters should meet BS EN 847 Part 1.[3]

Safeguarding of vertical spindle moulders

To reduce the risk of contact with the cutter block during rundown, machines must be fitted with a **braking** device that brings the block to rest within ten seconds. The deadline for fitting a braking device was 5 December 2005.[1, 4]

The type of tooling in use and the height at which it is set will determine the size of the hole in the table (i.e. the gap between spindle and table). Use **table rings** to close the gap to a minimum, see Figure 1. This reduces the risk of the work piece dipping and catching the edge as it passes over the gap.

For most work, the cutters on vertical spindle moulding machines can be guarded to a high standard. Where this is not possible, use jigs or work holders and stops.

No single type of guard or safety device can deal adequately with the variety of work which can be done on these machines. You must assess each job carefully and provide the best protection to suit the particular circumstances.

Backcutting or **climbcutting** (feeding the work piece in the same direction as spindle rotation) is a highly dangerous operation. This is because the machinist cannot exert any force to resist the sudden forward movement of the work piece if the cutter snatches. It should be discouraged even if a jig or work holder is used. Wherever possible, feed the work piece to the tool against the direction of spindle rotation.

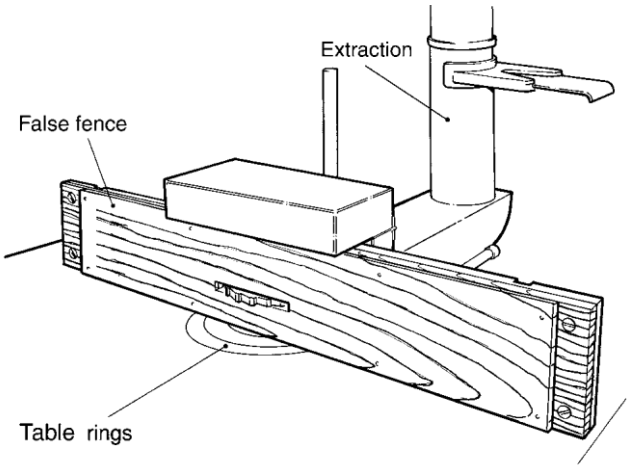


Figure 1 The use of a false fence greatly reduces the exposure of dangerous parts

Tooling

Always use limited cutter projection tooling on handfed machines such as vertical spindle moulders. This has been a legal requirement since 5 December 2003.[3] This type of tooling reduces the risk of kickback and the severity of injury should the operator's hand contact the tool, see Figure 2. Such tooling should be designed to BS EN 847-1[3] and more detailed guidance can be found in Woodworking Information Sheet WIS37.[5]

Only tools marked 'MAN' (meaning hand-feed) should be used on vertical spindle moulders, even if a demountable power feed unit is to be used.

On new (CE-marked) machines, the spindle should not be supplied with a slot for inserting cutter blades (known as a French or slotted spindle). On old (i.e. pre-CE marked) machines, the use of such spindles is not legal as they should have been phased out by 5 December 2003.[3]

Straight work

This includes work where the moulding extends over the full length of the work piece and stopped work where the cut extends over part of the length of the work piece. The cutters, cutter block and spindle behind the fence should be fully enclosed by a suitably designed guard which allows for the connection of dust exhaust outlets.

Before machining starts, the gap between the outfeed and infeed fences must be closed by the attachment of a false fence allowing only that part of the cutter which is cutting to be exposed, see Figure 1. A false fence will also provide good work piece support and prevent the work piece from 'dipping in' between fences. However, it may be necessary to fit a different false fence for every job.

Before the cutter is broken through the false fence, the area where the cutter will break through must be protected by top and side pressure pads big enough to prevent access to the cutters. Breaking in is then achieved by either pushing/adjusting the fence assembly back onto the cutter, or by raising the cutter up into the false fence (the method used will depend on the type of tooling in use).

To provide work piece support for long lengths of timber, use extension tables or roller trestles, see Figure 3.

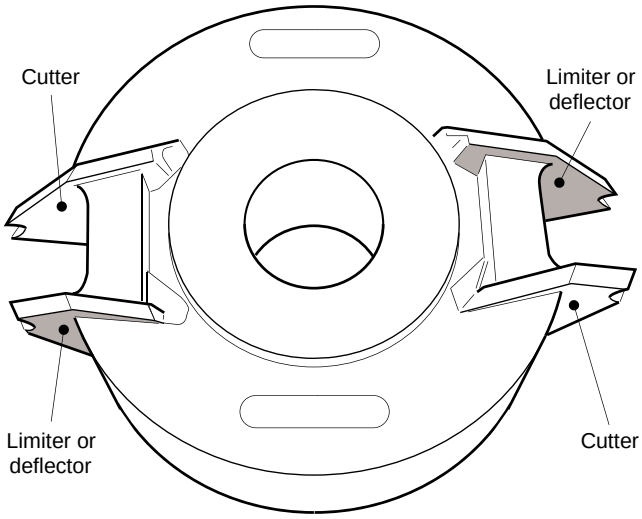
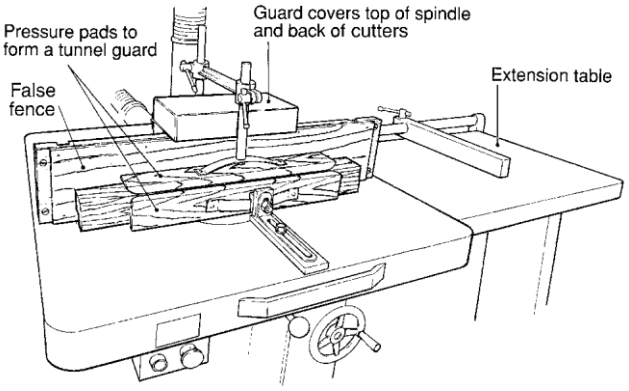


Figure 2 Example of limited cutter projection tooling



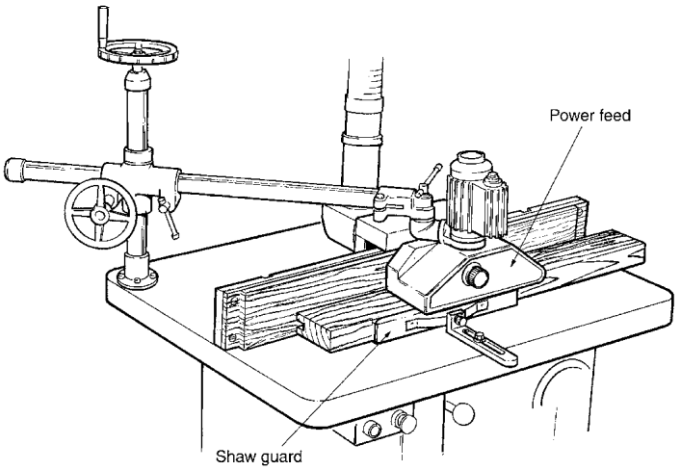


Figure 3 Vertical spindle moulding machine fitted with two Shaw guards forming a tunnel. The dimensions of the pressure pads prevent access by the operator to the cutters when the work piece is removed

Figure 4 Use of power feed and side pressure pad for straight work

Full length straight cuts

Where possible a demountable power feed unit should be used for straight cuts. This should be easily adjustable to suit different sizes of work piece and should not, in itself, create a trapping hazard. Used in conjunction with a side pressure pad, a power feed unit often represents the best method of guarding, see Figure 4.

Where a demountable power feed unit cannot be used, the cutting area should be enclosed by vertical and horizontal spring-loaded pressure pads. These pads form a tunnel, see Figure 3, through which the work piece can be safely fed with a push-stick (see Figure 5).

Figure 5 Push-stick

The top and side pressure pads should be made of hardwood and be the same width and depth as the work piece. Those supplied with some newer machines may be plastic or light alloy. They must also be long enough to prevent operators' hands from reaching the cutters. Pads of various lengths and widths will be necessary to accommodate a range of work piece sizes.

The machining of thin panels may only require use of a top pressure pad (see Figure 6).

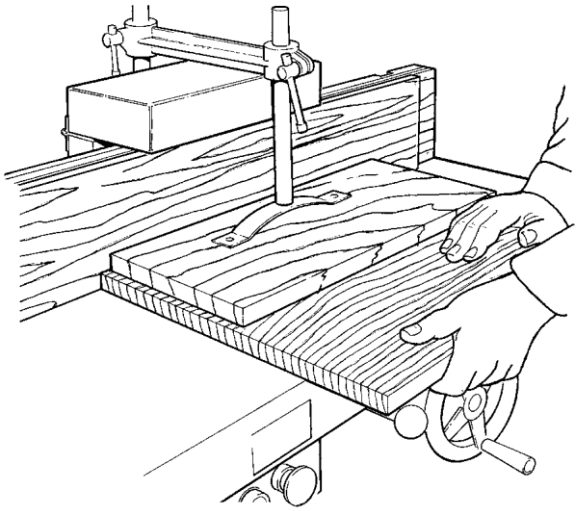


Figure 6 Straight work with only the top pressure pad in use

When a wide or heavy cut is made, especially on thin material, the fence may not give adequate support to the moulded section of wood. Adequate support can be provided by fixing a packing piece, which is a mirror image of the moulding, to the out-feed side of the fence.

Straight work with stopped cut

The cutters may have to break into the solid face, instead of starting the cut at the beginning of the work piece and/or have to break out before reaching the end. Because a guard cannot be used which is fully effective in preventing contact with the cutters (except on thin work pieces) jigs should be used. Access to the cutter from the top can, however, be prevented by using a top pressure pad.

Stops allow for greater control of the jig, allow greater stability of the work piece and prevent kick-back when 'dropping on'. Typically, the jig containing the work piece is placed against a backstop, fed slowly onto the cutters to break in, then fed forward against the false fence to the front stop and the jig taken off, see Figure 7.

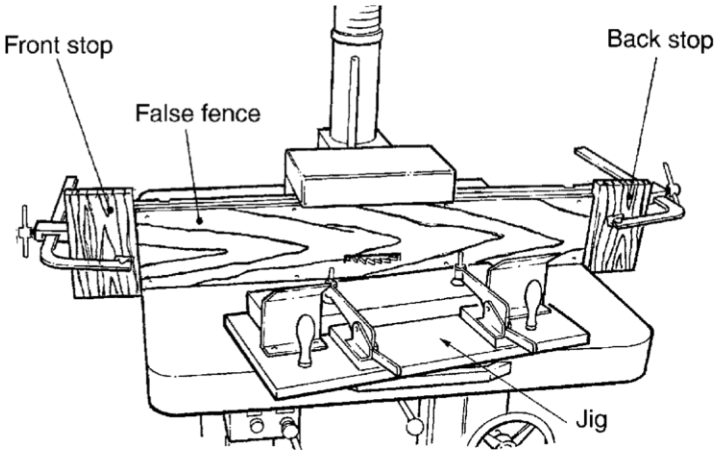


Figure 7 Jig (note toggle clamps and handles) and back/front stops for producing stopped work

Newer alloy jigs are also available, see Figure 8

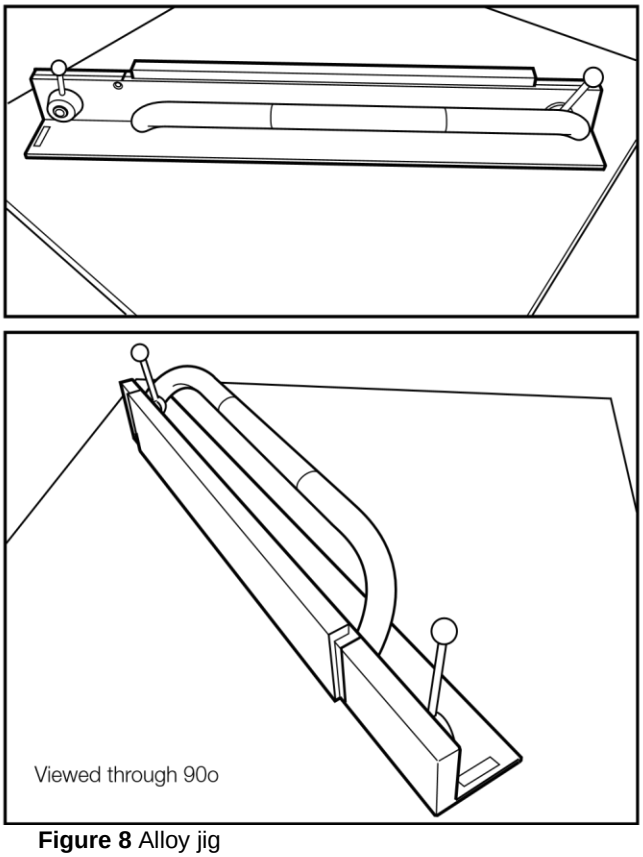


Figure 8 Alloy jig

In cases where it is not practicable to hold the work piece in a jig or holder (e.g. large window frames, doors etc.), the operator's hands need to be safely positioned well away from the cutters. In these circumstances, stops need to be robust enough to provide a firm support for the work piece.

Shaped or curved work

When setting up for shaped or curved work, the straight fence is removed and a guiding device (ie a ring fence or ring guide), together with an adjustable guard (traditionally a 'bonnet' guard), is fitted to enclose as much of the spindle and cutter block as possible, see Figure 9.

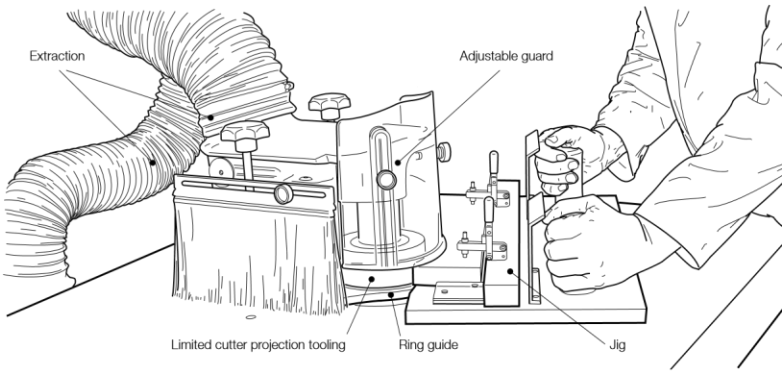


Figure 9 Example of guard and guiding device for curved work

Use jigs incorporating a template for all curved work. The template determines the outline of the finished shape and is held against a ring guide as the workpiece is moved past the cutter. The ring guide determines the line of cut and where possible it should be set above the cutters. However, for some operations it may have to be below the cutters. The ring guide is used as a lead-in and guide to the template or workpiece.

Large, small or complex workpieces

In general, it is possible to use a jig unless the workpiece is so large that a jig would make the job unmanageable or the workpiece is so small or complicated that it cannot be held securely in a jig.

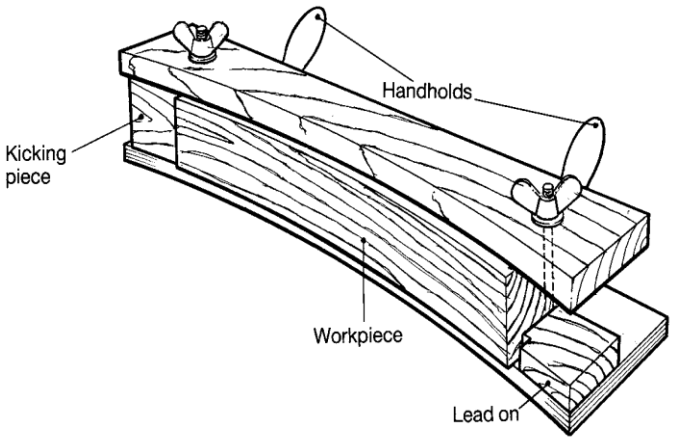
Small and complex shapes may require you to use a spike or push-stick, see Figure 5. Alternatively, a leading device fixed to the machine table may facilitate safe feeding of the work piece.

Design of jigs and work holders

The use of jigs and work holders is necessary for all stopped and curved work, unless the nature of

the operation makes it impracticable. Even if work pieces are irregularly shaped and there is a limited production run, jigs should always be used.

The design of jigs and work holders is determined by the work to be done and they are typically made of hardwood and plywood, although newer designs using alloys are also available, see Figure 8. They should allow quick and accurate location of the work piece which should be held firmly in position. Jigs should have secure handles and wide bases, so that machinists have a firm grasp at a safe distance from the cutters. The work piece should be clamped or secured within the jig. The most convenient method of holding the work piece in



the jig is to use manually operated quick-acting clamps which work with either a toggle or a cam action. Hand shields in front of operators' hands provide additional protection, see Figures 7 and 9.

With curved work, a combined template and jig helps ensure that work is held firmly and correctly to produce the required shape and finish. Box jigs are particularly useful as they allow better control of the work piece and reduce or prevent breakout. The template should also be extended horizontally, beyond the nose and tail of the work to provide lead-in and lead-out control, for safe working, see Figure 10.

Figure 10 Box jig

References

1 *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 (as applied to woodworking machinery). Approved Code of Practice and guidance* L114 (Second edition) HSE Books 2014 www.hse.g.ov.uk/pubns/books/l114.htm

2 BS EN 848-1:2007+A2:2012 *Safety of woodworking machines. One side moulding machines with rotating tool. Single spindle vertical moulding machines* British Standards Institution

3 BS EN 847-1:2013 *Tools for woodworking. Safety requirements. Milling tools, circular saw blades*
British Standards Institution

4 *Retrofitting woodworking machine brakes* Woodworking Information Sheet WIS38(rev1) HSE
2013
http://www.hse.g.ov.uk/woodworking/wis.htm

5 Tooling for use with hand-fed woodworking machines Woodworking Information Sheet WIS37(rev1) HSE 2014 http://www.hse.g.ov.uk/woodworking/wis.htm

Further reading

Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of

Practice and guidance L22 (Fourth edition) HSE Books 2014 www.hse.g.ov.uk/pubns/books/l22.htm

More information on vertical spindle moulders, including videos illustrating correct working practices, can be found on HSE's woodworking website: www.hse.g.ov.uk/woodworking/spindlemoulder.htm

Further information for suppliers, installers and users of new and second-hand machinery can be found on HSE's Work equipment and machinery webpages: http://www.hse.g.ov.uk/work-equipment-machinery/ index.htm

Further information

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Hand-fed surface planing machines
Safe working practices
HSE information sheet

Introduction

This information sheet is aimed at employers and others who have control of how surface planing machines are used. Machine operators will also find this information of use.

Accident history

Surface planing machines are a common cause of accidents. Many of these occur during edging or flatting, rather than the specialised operations such as rebating, moulding or chamfering. Analysis of woodworking accidents has found that the two most common causes were missing or inadequate guarding and lack of training. It is therefore important that you train operators to correctly set the guards and use safety devices such as push blocks where necessary.

Training issues

No one should be allowed to work on a surface planing machine unless they have demonstrated competence. It is advisable that competent operators are authorised in writing by a responsible person (director, senior manager etc..). This will then form part of the training records. Anyone who supervises the use of any work equipment should have access to information and where appropriate, written instructions.[1]

Legal requirements

Le.g..al requirements covering the use of these machines are contained in *Safe use of woodworking machinery: Provision and Use of Work Equipment Regulations 1998 (as applied to woodworking machinery). Approved Code of Practice and guidance*.[1]

This document gives practical advice on the safe use of woodworking machinery and covers the provision of information and training as well as aspects of guarding and maintenance (see also Further reading).

When buying a new surface planer, it should be supplied with a declaration of conformity and have a CE mark. Designers and manufacturers must conform to the essential safety requirements of the Machinery Directive and associated European Free Trade Association (EFTA) Regulations. One way of achieving this is by designing and constructing the machine to meet BS EN 859.[2] Cutter blocks should meet BS EN 847 Part 1.[3] However, there are many older machines still in use and the guarding requirements for these machines will also be covered.

Safeguarding of hand-fed planing machines

To prevent access to the cutter block there should be guards in front of and behind the fence. The fixed guard behind the fence is attached either to the fence or to the fence support and is designed to move with the fence as it is adjusted. A bridge guard is used to prevent access at the front of the fence. Both guards must be capable of covering the full length and diameter of the cutter block.

In general, all bridge guards should be:

■ Strong, shock- and compression-resistant and made from a material such as plywood or light alloy, so that in the event of contact with the cutter block, neither the guard nor the cutter block will disintegrate;

■ Easily adjustable without the aid of a tool but not easily deflected, which would expose the cutter block;

■ Capable of being adjusted to make the gap between the fence and the guard as small as possible, see Figure 3;

■ Capable of being adjusted to make the gap between the bridge guard and the work piece upper surface (or table) as small as possible, see Figures 3 and 4.

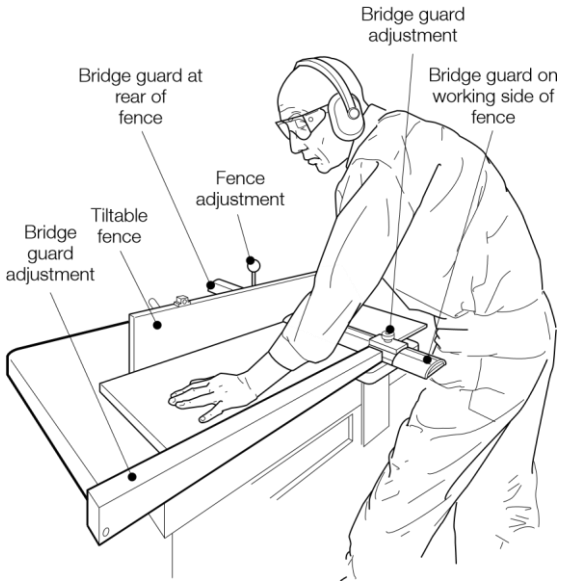


Figure 1 Basic safeguarding requirements

Details of the bridge guard specifications for newer machines are shown in Figure 1. These include the requirements for it to be:

■ Flat or convex in shape with a smooth upper surface without projecting parts;

■ Possible to lock in any horizontal position;

■ Adjustable in height up to a maximum of 75 mm above the outfeed table;

■ Not possible to remove it from the machine unless a tool is used;

■ Capable of being adjusted manually or

automatically so as to make the gap between the fence and the guard at most 6 mm, regardless of the position of the fence and tables;

■ Capable of being adjusted manually or automatically so as to make the gap between the bridge guard edge and the work piece upper surface a maximum of 2 mm at infeed table side and 4 mm at the outfeed table side.
See BS EN 859 for further details.

There are many old-style ‘telescopic’ bridge guards still in use on older machines, as detailed in Figures 8 and 10. This is acceptable provided that they meet the necessary legal requirements.[1] The main difference between these and the new style is that being in two pieces they do not have a smooth upper surface.

Braking

To reduce the risk of contact with the cutter block during run down, machines should be fitted with a braking device that brings the blade to rest within ten seconds. Unless already fitted with a manual or foot operated brake, surface planers with a rundown time greater than ten seconds should have been fitted with a braking device by 5 December 2003.[1,4]

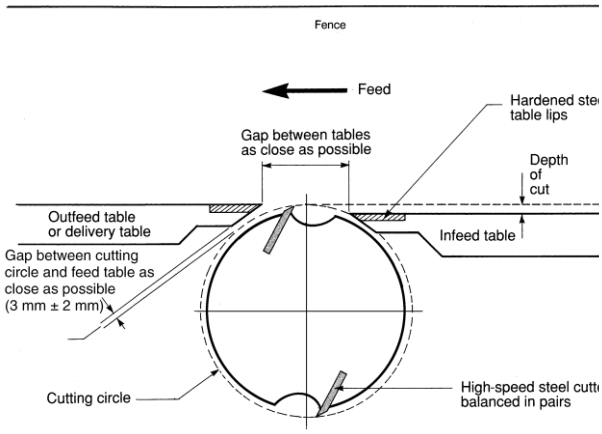


Figure 2a Table height and gap

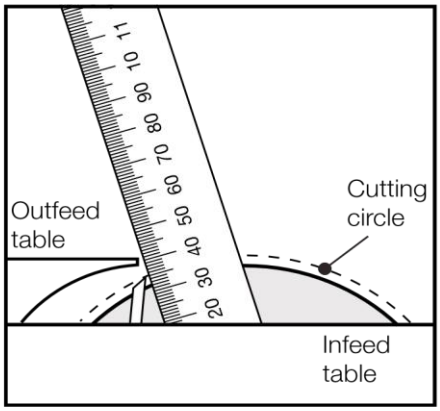


Figure 2b Measuring gap between table edge and cutters

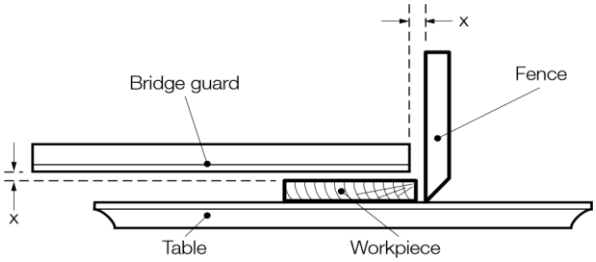
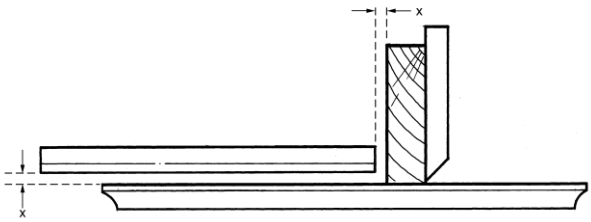


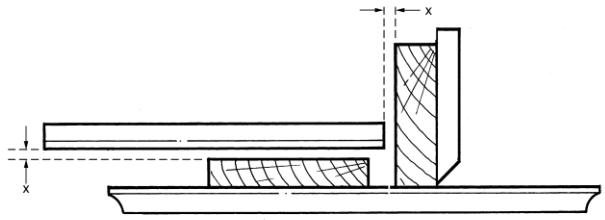
Figure 3 Adjustment of the bridge guard – Flatting

Note: Bridge guard to be adjusted as close to the work piece and fence as possible (x)



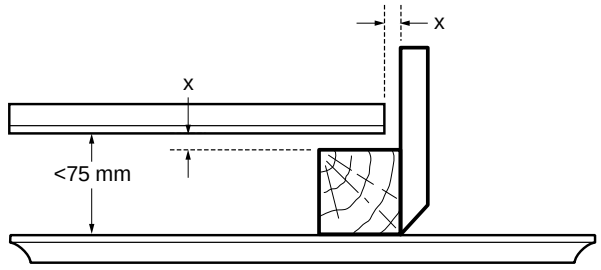
Note: Bridge guard to be adjusted as close to the workpiece and table as possible (x).

Figure 4 Edging



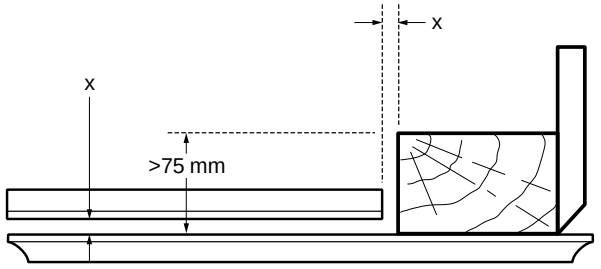
Note: Bridge guard to be adjusted as close to the workpiece as possible (x).

Figure 5 Flatting and edging rectangular stock



Note: Bridge guard to be adjusted as close to the workpiece and fence as possible (x)

Figure 6 Flattening and edging small square stock



Note: Bridge guard to be adjusted as close to the workpiece and fence as possible (x)

Figure 7 Flattening large stock

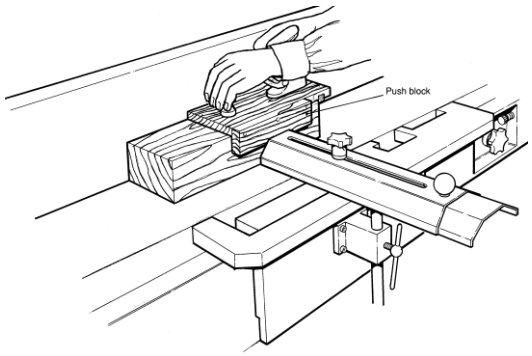


Figure 8 Push blocks for use with short pieces of timber

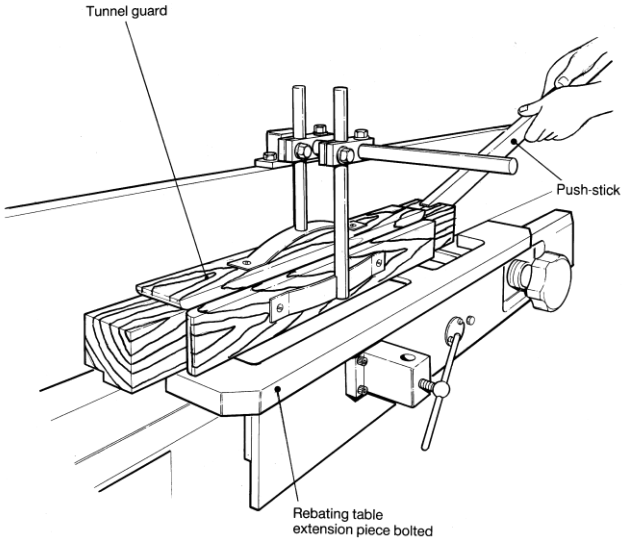


Figure 9 Rebating using a rebating table, Shaw guards and push stick

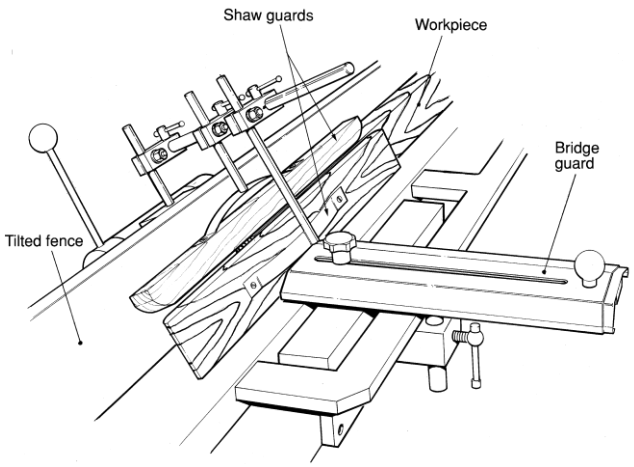


Figure 10 Bevelling using a tilted fence and Shaw guards

Tooling and table setting

Correctly setting the tables and the cutter block is crucial not only to the quality of the work, but also to the safety of the operation.

Only cylindrical (or 'round form') cutter blocks marked MAN should be used on hand-fed planing machines, see BS EN 847-1.

Follow the tooling manufacturer's recommendations for:

- Balancing the cutter block assembly;
- The minimum clamping length of knives;
- The correct torque for screw fixings.

You should also sharpen knives at regular intervals to reduce the risk of injury from snatching or kickback.

The clearance distance between the cutting circle and the lips of the infeed and outfeed tables should be as small as practicable, BS 859[2] states that it must be 3 mm ± 2 mm, see Figure 2. The measurement should be made radially in line with the centre of the cutter block. This outfeed table height should never be below the cutting circle diameter.

Any slots on the table or table lips to reduce noise should not be more than 6 mm wide and have a minimum tooth thickness of 1.5 mm at the tip.

Once the cutter block and table have been set remember to correctly position the guards before any trial cuts are made.

Using the hand-fed planing machine

Failure to adjust the bridge guard and fence to give the optimum degree of protection has been the cause of many serious injuries. The correct positions of the bridge guard for various flattening and edging operations are shown in Figures 3 to 7. The fence should always be adjusted to the width of material being cut, therefore reducing the amount of exposed cutter.

When flatting, the bridge guard should be placed over the work piece when it is less than 75 mm, see Figures 3 and 6. It is important to position your hands correctly on the work piece when machining. When applying hand pressure keep your hands on top of the work piece. If they are at the sides they will be closer to the cutters. When flatting, the work piece should be fed by pressure with the right hand, the left hand holding it down initially on the infeed table. As soon as there is enough timber on the outfeed table, the left hand can pass safely over the bridge guard to apply pressure on the outfeed table, followed by the right hand to complete the feeding operation.

If the work piece is greater than 75 mm, or when edging, then the bridge guard should be positioned at the side of the work piece, as shown in Figures 4 and 7. However, it is not necessary to exert feeding pressure directly over the cutter block and your hands should not pass over the cutter block when it is in contact with the timber unless using a feeding device such as a push block. Your hand's main function is to exert horizontal pressure on the work piece and maintain it square to the fence.

Safety devices

Provide a push block made from plastic, wood or plywood for use on all machines. You should also make provision for storing push blocks on the machine. It should have well designed handles to give the machinist a firm grip, see Figure 8.

You should also always use a push block when planing short pieces. This will reduce the risk of a short work piece dipping as it passes the lip of the infeed table, which results in abrupt contact with the cutters and can cause the work piece to kick back.

Rebating and bevelling

PUWER 98 requires that the most suitable (i.e. lowest risk) machine available is selected for every machining operation. For example, cutting a rebate on a properly guarded vertical spindle moulding machine is lower risk than a surface-planing machine.[1]

Stopped work should never be done on a hand-fed planing machine – e.g.. only use the machine for jobs involving the full length of the work piece.

Any CE-marked planing machines (manufactured after 1995) should be designed so that it is not possible to carry out rebating using the end of the cutter block.[2] On old (e.g.. pre-1995) machines, rebating using the end of the block can be done provided a more suitable machine is not available and that:

■ The work piece is properly supported (see Figure 9);

■ A tunnel guard is formed, e.g.. by means of Shaw guards, which prevents the operator's hands from reaching the cutter block;

■ The table gap is guarded on both sides of the fence; ■ Correctly ground cutters are used to reduce the risk of work piece kickback.

Note: The extended pads on the Shaw guards (Figure 9) effectively prevent access to the cutter block even when there is no work piece.

Angled cuts (i.e. bevels) need adequate work piece support. As for rebating, Shaw guards can be used to make a tunnel guard through which the work can be fed, see Figure 10.

Power feed

Consider using a demountable power feed device, particularly for work pieces over 75 mm in thickness. As with other hand-fed machines, such as a vertical spindle moulder, it removes the need for the operator to approach too close to the cutter block. A power feed device can also overcome the risk of kickback. However, using power feed does not remove the need for guarding, particularly as the feed unit needs to be mounted on the outfeed table for surfacing.

Maintenance

Machines, particularly safety devices and guards, should be adequately maintained to ensure safety.[1] You should consider how your workers use machinery and have adequate maintenance arrangements in place to ensure it remains safe. Unless a bridge guard moves freely (both vertically and horizontally) it is unlikely to be kept adjusted.

■ Lubricate machines regularly.

■ Make sure any damage is reported and replace parts as required.

■ Change the pads on Shaw guards regularly to suit the size of the work piece. The fixing screws need to be in good condition – keep spares available and have the right tools to hand.

■ Inspect and replace the handles on push blocks regularly – they should be secure.

References

1 *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 (as applied to woodworking machinery). Approved Code of Practice and guidance* L114 (Second edition) HSE Books 2014 www.hse.g.ov.uk/pubns/books/l114.htm

2 BS EN 859:2007+A2:2012 *Safety of woodworking machines. Hand fed surface planing machines* British Standards Institution

3 BS EN 847-1:2013 *Tools for woodworking. Safety requirements. Milling tools, circular saw blades* British Standards Institution

4 *Retrofitting braking to woodworking machines*
Woodworking Information Sheet WIS38(rev1) HSE 2014 www.hse.g.ov.uk/woodworking/wis38.htm

Further reading

Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance L22 (Fourth edition) HSE 2014 www.hse.g.ov.uk/pubns/books/l22.htm

More information on surface planers, including videos illustrating correct working practices, can be found on HSE's woodworking website: www.hse.g.ov.uk/work-equipment-machinery/index.htm

Further information for suppliers, installers and users of new and second-hand machinery can be found on HSE's Work equipment and machinery webpages: www.hse.g.ov.uk/work-equipment-machinery/index.htm

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Wood turning lathes
Safe working practices

HSE information sheet

Introduction

This information sheet gives practical guidance on safe working practices when using hand, copy and rotary knife wood turning lathes. It is aimed at employers and others who have control of how wood turning lathes are used. Machine operators will also find this information of use. Effective safeguards such as interlocked enclosures are often used on automatic copy lathes. However, the simpler hand turning lathes are much more reliant on a safe system of work to control the risks.

Accident history

Accidents have been caused on wood turning lathes because the operator has:

- Made contact or become entangled with a rotating part or work piece, often while using sandpaper/ emery tape or similar;
- Made contact with rotating cutters, often while attempting to move or un-jam a work piece (rotary knife lathe only);
- Been crushed between a rotating work piece and tool rest, a moving carriage, swinging arm or turret;
- Been struck by an ejected work piece (or cutters).

It is important that the necessary safeguards or safe systems of work are in place for a particular lathe and operators are trained to use/follow them.[1] There have been several prosecutions because safeguards were either not fitted or had been defeated on copy and rotary knife lathes, often resulting in serious accidents.

Training and information

It is important that the machine is fitted with the necessary safeguards and machine operators are trained to use them and carry out the work they are expected to do safely. Training is particularly important for those using hand turning lathes, where the operator works close to the rotating work piece and the risk is controlled by working safely. This should include the provision and use of personal protective equipment such as eye protection and ear defenders etc.

With rotary knife lathes, setters require detailed training and experience before taking responsibility for cutter setting, to control the risk of ejected cutters. This should include a systematic check of knife security before any rotary knife lathe is started.

No one should be allowed to work on a lathe unless they have demonstrated competence. It is advisable that competent operators are authorised in writing by a responsible person (director, senior manager etc.). This will then form part of the training records. Anyone who supervises the use of work equipment must also have received adequate training and both operators and supervisors must have access to

information and where appropriate, written instructions.[1] There should also be effective maintenance in place.

Legal requirements

Le.g..al requirements covering the use of wood turning lathes are contained in *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 (as applied to woodworking machinery). Approved Code of Practice and guidance*.[1] This document gives practical advice on the safe use of woodworking machinery and covers the provision of information and training as well as aspects of guarding and maintenance (see also Further reading).

When buying a new wood turning lathe, it should be supplied with a Declaration of Conformity, a suitable operator's handbook giving safety information and have a CE Mark properly applied. This means that the manufacturer declares that the machine complies with The Supply of Machinery (Safety) Regulations 2008.

Hand turning lathes

Hand turning lathes cannot be effectively guarded because of the way the machine is used. However, the dangers of working on hand turning lathes are well known and can be controlled if the user follows an established safe system of work.

It is important that the necessary safeguards or safe systems of work are in place for a particular lathe and operators are trained to use/follow them.[1]

Hand turning lathes are often used in schools and colle.g..es, see Figure 1. As with most wood lathes, the work piece is mounted between centres and the operator then uses various types of hand-held chisel or gouge placed on a tool rest to cut the wood from the rotating work piece.

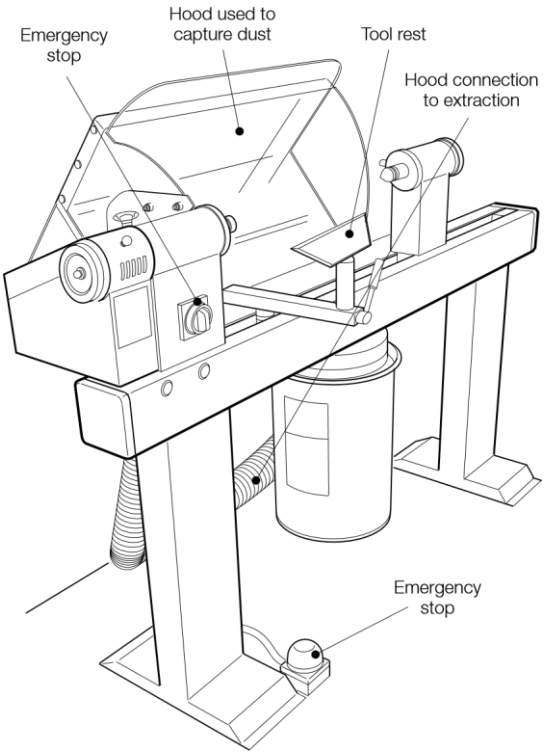

Figure 1 Small hand turning lathe typically used in schools

Supporting the work piece

The drive centre, located in the rotating headstock, can be fitted with spurs etc. to give a more positive hold onto the work piece and reduce the risk of ejection, see Figure 2. For a larger diameter/heavy work piece, additional support from face plates screwed into the ends may be required, see Figure 3. For maximum support the correct gauge of screw should always be used. A single face plate fitted to the headstock is used where one end/face of the work piece has to be worked, for example when turning a wooden bowl.

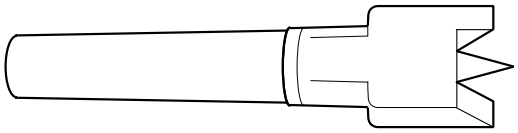

Figure 2 Four-spur driving Centre

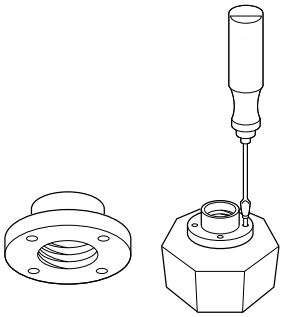

Figure 3 Face plate screwed to work piece

Risk of ejected work piece

Ejected work pieces are one of the main causes of accident during hand turning. Ejection can occur if there is:

- Incorrect/inadequate work piece support;
- Inadequate work piece preparation – it is important that surplus timber is removed from a square section work piece before turning commences, see Figure 4;
- Too fast a speed selected for larger diameter or irregularly shaped work pieces, particularly if first cuts are being made;
- A blunt tool being used.

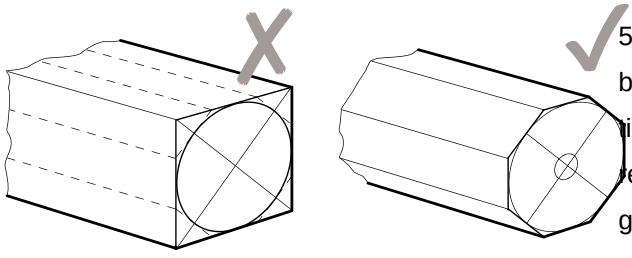

Figure 4 Removing surplus timber from a square section work piece before turning

Risk from tool post setting errors

The tool rest should be set close enough to ensure the user can hold the chisel steady with the minimum of effort but it should be far enough away from the work piece to ensure the parallel portion of the chisel is in contact with the rest at all times during cutting operations.

The tool rest height should be such that the chisel cutting edge is set at the work piece centre line. The user must be prepared to adjust the tool rest if the cutting conditions are not ideal.

Risk from entanglement/trapping

Because the operator works in close proximity to the rotating work piece during hand turning, there is a higher risk of entanglement. The risk can be reduced by:

- Use of a hairnet, or hat with integral hairnet, if the operator has long hair;
- Ensuring there is no loose clothing, particularly around the wrists or arms;
- Removing jewellery/watches etc. from fingers and wrists.

Trapping accidents can occur during sanding operations on all types of lathe. Most accidents happen when each end of a strip of sandpaper is held in separate hands and passed around the back of the component being sanded, see Figure 5a. If it is wrapped around the fingers and/or becomes snagged on the component while it is tightly gripped, then a serious injury is likely. To reduce the risk, use a backing board made of good quality wood, see Figure 5b.

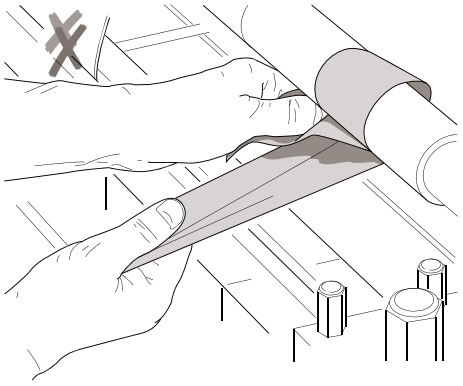

Figure 5a Trapping risk when sanding

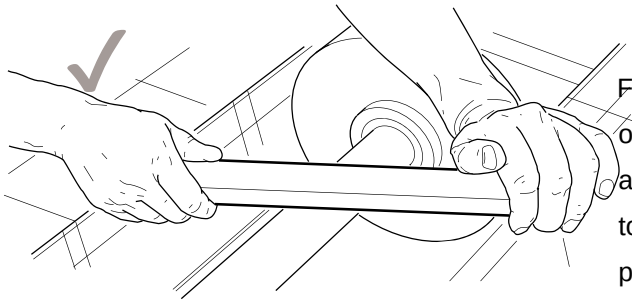

Figure 5b Use of a backing board for sanding

If the use of a backing board is not practical, then the sandpaper should be used in long strips with one end passed beneath the work piece. Force should then be applied by pulling both ends of the strip upwards. The strip should never be allowed to go slack or be wrapped around either the operator's finger or the components.

Copy lathes

Copy lathes can be simple hand-operated models (see Figure 6), semi-automatic or fully-automatic (see Figure 7). They work by having a spring-loaded or hydraulically-operated guide that follows a template. The tool then cuts the same profile onto the work piece being turned by following the guide via a system of linkages or hydraulics etc. As the operator does not need to be in close proximity to the rotating work piece, hand-operated copy lathes should have appropriate guarding.

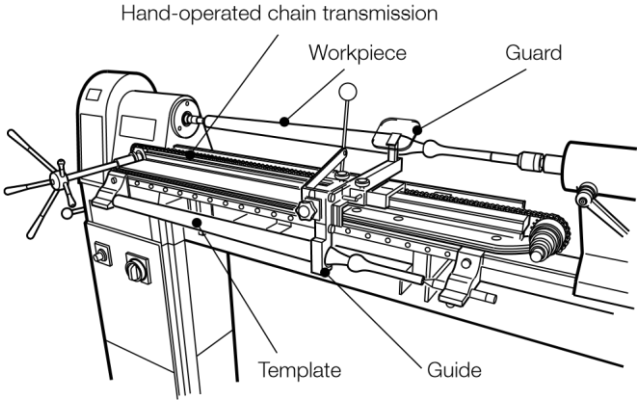

Figure 6 Simple hand-operated copy lathe

Fully-automatic CNC copy lathes have a number of heads and cutting tools that allow roughing out and finishing cuts without having to change any tools. They can be programmed to automatically produce large numbers of complex work pieces rather than following a template. Some copy lathes are specifically designed for batch production of small wooden parts. There is generally better safeguarding on an automatic copy lathe, with even basic models having adjustable shield guards. More sophisticated machines have all dangerous parts fully enclosed behind an interlocked door, see Figure 7. Automatic copy lathes have a high output and are often magazine-fed but output is usually less than that of a rotary knife lathe. They are however more widely used being more versatile, safer and quieter than a rotary knife lathe. They can also be fitted with an automatic surface grinding/sanding unit, see Figure 8, which reduces the risks to the operator as well as being more efficient.

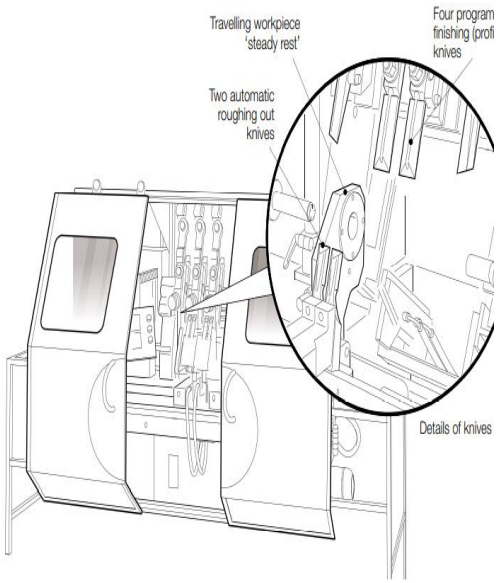

Figure 7 Fully hydraulic automatic copy lathe with interlocked enclosure

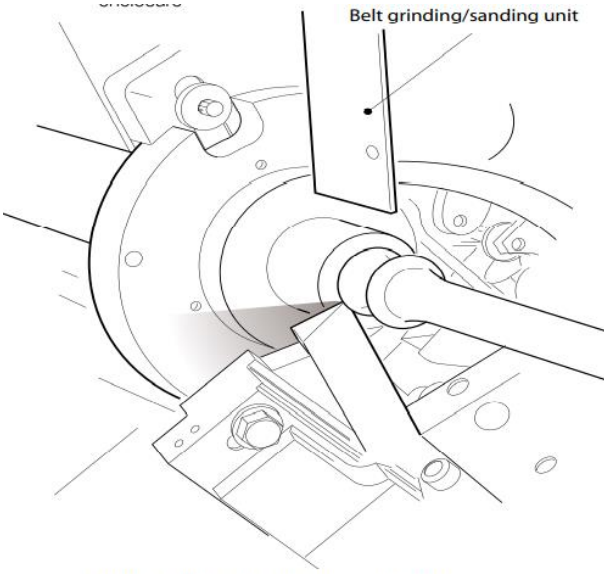

Figure 8 Automatic grinding/sanding unit

Rotary knife lathes

Rotary knife lathes have a cutter-block mounted on a fixed spindle or arbour which then rotates as well as the work piece, see Figure 9.

Although it is possible to fit limited cutter projection tooling to some older rotary knife and copying lathes,[1] BS EN 847–1[2] does not specifically apply to these machines. However, its guidance is relevant to rotary knife machines and should be followed where possible. The standard also advises that 'where there is a hazard of ejection and contact with the tool it is always prevented by a system of fixed guards and/or movable guards interlocked with guard-locking and/or self-closing guards'. This comment should be carefully considered when assessing and controlling the risks on copy and rotary knife lathes, particularly with older machines that cannot be fitted with limited cutter projection tooling.

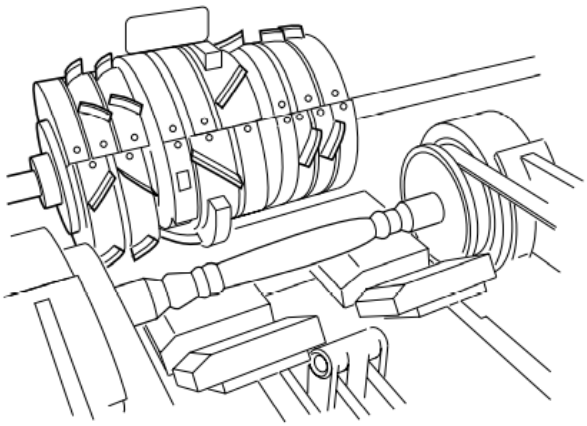

Figure 9 Modern rotary knife tooling

In addition to the accident risks discussed previously, consideration should also be given to potentially high levels of noise and wood dust exposure, see 'Other hazards'.

There are three classes of rotary knife lathe:

- Manually-operated;
- Semi-automatic;
- Fully-automatic.

Manually-operated lathes are where the rotating work piece is moved into contact with the rotating cutters, either on a sliding carriage or between swinging arms, by a manually-operated lever.

Semi-automatic lathes that operate on a single cycle and one or more of the following functions are automated:

■ Clamping of the work piece;
■ Advancing the work piece onto the cutter-block;
■ Advancing the cutter-block onto the work piece; ■ Magazine loading.

These lathes are classed as semi-automatic as the operator has to either manually load the work piece or operate a lever to bring the work piece into contact with the cutters.

Fully automatic lathes are where the operator has only to feed stock into a magazine or onto a conveyor and work pieces are discharged automatically on completion.

Safeguarding rotary knife lathes

Contact with the cutters should be prevented by effective enclosure of the cutter head. Where possible, this should be achieved by the use of an interlocked guard with guard locking, i.e. the guard cannot be opened until the cutters are stationary, see Figure 10. All transmission machinery and other dangerous parts should also be safeguarded.

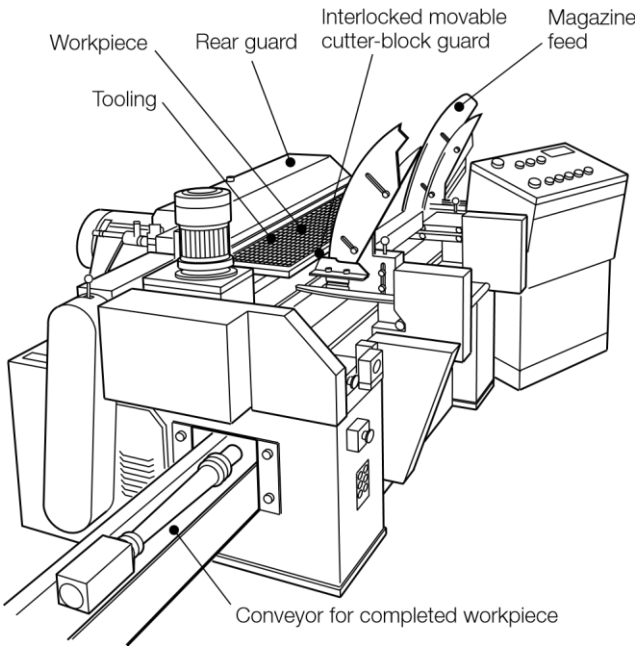

Figure 10 Automatic rotary knife lathe with interlocked movable cutter-block guard and guard locking

Where an interlocked guard is used on any lathe, openings in the guard should be restricted to comply with the safety distances given BS EN ISO 13857.[3] Also, any interlocks used should meet the requirements of BS EN ISO 14119.[4]

Some older manual and semi-automatic rotary knife lathes may not be able to achieve this standard of guarding. However, as a minimum they should be fitted with a rise and fall shutter guard, linked with the saddle feed mechanism, so that the cutter is enclosed at all times when cutting is not taking place. An additional pivoting guard should also be linked with the saddle feed mechanism so that access to the cutter-block and work piece is prevented during cutting, see Figures 11 and 12.

An automation upgrade will also improve safety, i.e. by the addition of a magazine/conveyor feeding.

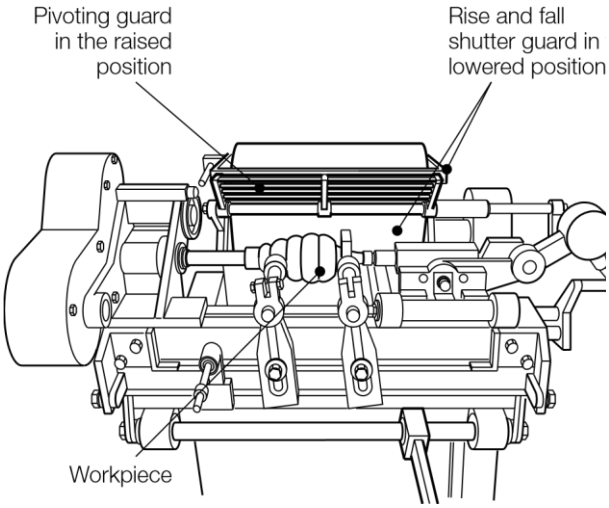

Figure 11 Position of guards during loading of the work piece (shutter guard encloses stationary cutters, pivot guard raised so next work piece can be loaded)

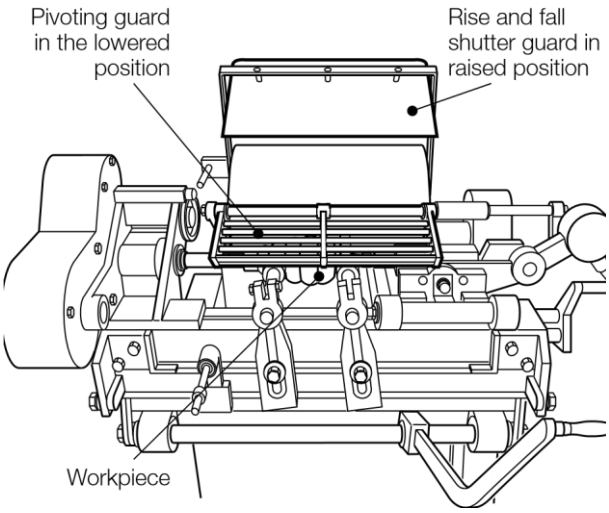

Figure 12 Position of guards during machining of the work piece (pivot guard lowered to prevent access to rotating cutters and work piece, shutter guard in raised position)

Braking

Lathes come within the category of woodworking machine that require braking to be fitted where a risk assessment shows it to be necessary. Some lathes may not be suited to have braking fitted as sudden stopping could affect the integrity of the work piece or the machine. However, if a risk is identified that could be controlled by braking and it would not affect integrity then automatic braking may need to be provided. This should stop the lathe within ten seconds unless the run-up time exceeds ten seconds. In that case the automatic braking should stop the lathe in less time than the run-up time, but should not exceed 30 seconds.

Lathes should have been fitted with a braking device if supplied after 5 December 2003.[1,5]

Other hazards

To control wood dust exposure, effective hoods connected to an extraction system should be used, see Figure 1. More information can be found in *Wood dust: Controlling the risks*.[6]

Noise levels on rotary knife lathes can often be in excess of 100 dB(A). Some noise level reduction can be achieved by the use of chip limited cutters[7] and choosing the correct cutting speed. However, it may be necessary to build a noise enclosure around the machine to effectively reduce noise levels, see Figure 13. More information can be found in Woodworking Information Sheets 4[8] and 13.[9]

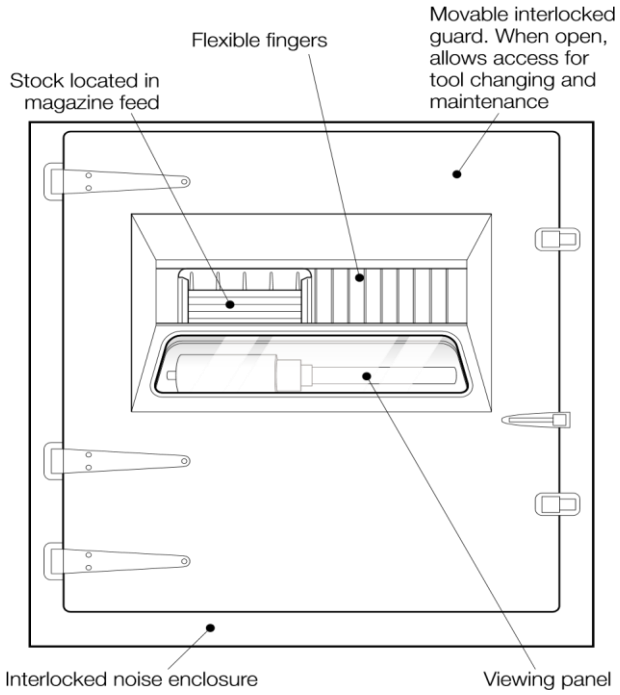

Figure 13 Interlocked noise enclosure

References

1 *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 (as applied to woodworking machinery). Approved Code of Practice and guidance* L114 (Second edition) HSE 2014 www.hse.g.ov.uk/pubns/books/l114.htm

2 BS EN 847-1:2013 *Tools for woodworking. Safety requirements. Milling tools, circular saw blades* British Standards Institution

3 BS EN ISO 13857:2008 *Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs* British Standards Institution

4 BS EN ISO 14119:2013 *Safety of machinery. Interlocking devices associated with guards. Principles for design and selection* British Standards Institution

5 *Retrofitting woodworking machine brakes* Woodworking Information Sheet WIS38(rev1) HSE 2014

www.hse.g.ov.uk/woodworking/wis.htm

6 *Wood dust: Controlling the risks* Woodworking Information Sheet WIS23(rev1) HSE 2012 www.hse.g.ov.uk/woodworking/wis.htm

7 *Tooling for use with hand-fed woodworking machines* Woodworking Information Sheet WIS37(rev1) HSE 2014 www.hse.g.ov.uk/woodworking/wis.htm

8 *Noise reduction at band re-saws* Woodworking Information Sheet WIS4(rev2) HSE 2014 www.hse.g.ov.uk/woodworking/wis.htm

9 *Noise at woodworking machines* Woodworking Information Sheet WIS13(rev1) HSE Books 2007 www.hse.g.ov.uk/woodworking/wis.htm

Further reading

Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance L22 (Fourth edition) HSE Books 2014

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 First published 08/17.

Narrow band saws
Safe working practices

HSE information sheet

Introduction

This information sheet gives practical guidance on safe working practices when using narrow band saws. It is aimed at employers and others who have control of how these machines are used. Machine operators will also find this information of use. A narrow band saw is one where the blades are ≤50 mm in width.

Accident history

Most band saw accidents are caused by contact with the moving blade while either cutting material or removing material/off-cuts from the table. Accidents also occur while setting, cleaning, adjusting and maintaining the machine while the blade is still in motion.

Legal requirements

Le.g..al requirements covering the use of these machines are contained in *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 as applied to woodworking machinery. Approved Code of Practice and guidance*.[1] This document gives practical advice on the safe use of woodworking machinery and covers the provision of information and training as well as aspects of guarding and maintenance.

When buying a new narrow band saw, it should be supplied with a declaration of conformity and have a CE mark. Designers and manufacturers must conform to the essential safety requirements of the Machinery Directive and associated European Free Trade Association (EFTA) Regulations. One way of achieving this is by designing and constructing the machine to meet BS EN 1807-1:2013+A1:2009.[2]

General safety issues

Risk assessment

Your risk assessment[3] should cover all foreseeable uses and operations at the band saw. It should identify the action needed to eliminate or control risks, for example making sure that the correct fences, holders, jigs etc. are available and that the operator knows how to use them correctly. As part of the assessment, you should also consider if there is a more suitable machine for the process or operation.

Some machines such as narrow band saws can often be inherently unstable and special steps may need to be taken to ensure that they remain stable during operation, i.e. fixing the machine to the floor.[1,2]

Training

It is important that machine operators are trained to carry out the work they are expected to do. No one should be allowed to work at a woodworking machine unless they have demonstrated competence. It is advisable that competent

operators are authorised in writing by a responsible person (director, senior manager etc..). This will then form part of the training records. Anyone who supervises the use of work equipment should have access to information and where appropriate, written instructions.[1]

Training for band saw operators should include:

■ Principles of machine operation, correct use and adjustment of the tilting table, fence, jigs, holders and templates;

■ Selection of the correct blade for the operation, the set of the teeth, tensioning and tracking of the blade;

■ Safe handling of the work piece when cutting and the position of the hands relative to the blade; ■ Correct adjustment of the top guide and guard and blade guard below the table.

Guarding the blade

Substantial guards should enclose the pulleys and the blade, except the part that runs downwards between the top pulley and the machine table. These are normally in the form of doors attached to the mainframe of the machine.

On new machines, these guards should be interlocked with the machine drive. If the stopping time of the saw blade exceeds ten seconds[4] then guard locking is also required.

Any access to the saw blade or other dangerous parts through the dust extraction outlet when the exhaust system is not connected should be prevented by having reach distances that meet the requirements of BS EN ISO 13857:2008.[5]

Between the table and the top pulley enclosure there should be an adjustable guard that fully encloses that section of the blade on all four sides, as shown in the illustrations. This is attached to and moved with the top blade guide. This adjustable guard should be either self-locking or capable of being locked in position. It should also have sufficient adjustment to enable movement down to the table.

The part of the blade between the underside of the table and the lower guide should be guarded at all angles of table tilt.

Safety devices

Guide blocks should be used when hand feeding against a fence. A push stick should be used for feeding timber close to the blade and removing cut pieces from between the saw and fence (see Figure 1).

Braking

An automatic braking device has been a requirement on narrow band saws since 5 December 2005.[1,4] The braked run-down time should be less than ten seconds, unless this would affect the integrity of the machine, in which case it should be less than 30 seconds.

Wood dust

Narrow band saws should be fitted with effective local exhaust ventilation to control wood dust. To capture the dust effectively collect it where the saw blade enters the casing, and by means of a low-level exhaust connection to the rear of the casing.[6]

Machine setting and maintenance

For a narrow band saw to cut accurately and efficiently it should be set up correctly. This includes making sure that before cutting:

■ The blade type and width are suitable for the material being cut and the blade thickness is suitable for the pulley wheel diameter, see 'Tool selection';

■ The blade teeth are sharp and properly set;

■ The blade is correctly tensioned and tracked.

Tensioning

A saw keeps its condition longer if the tension on the blade is relaxed after use, e.g.. at the end of a working period. Place a notice on the machine to remind operators of this and that the next user has to re-tension the blade before starting the saw.

Tracking

The blade is tracked by tilting the top pulley, which helps the blade run in the correct position on the band-saw pulleys. When tracking, the thrust wheels and guides should be clear of the blade to allow it to move freely. Isolate the machine and then rotate the top pulley by hand and tilt it until the blade runs in the correct position. Reposition the guides and thrust wheel and close the guards then run the machine under power. If the blade does not run correctly when under power, then repeat the manual tracking operation. Once tracking is finished, recheck the blade tension.

Saw blade guides and thrust wheels

The saw blade guides, which can be fixed pads, pegs or rotating rollers, should support the blade behind the gullets. They should not grip the blade but should support it during cutting.

The thrust wheels give support to the blade when cutting. They should be positioned in line and just clear of the back of the blade when the blade is idling after being tensioned and tracked. Lack of clearance will cause grooving of the thrust wheels and lead to blade failure.

Cleaning and maintenance

Never clean the blade or pulley with a hand-held brush or scraper while the blade is in motion. Careful adjustment and regular maintenance of blade and pulley cleaning equipment will ensure resin residues do not build up.

Draw up a routine maintenance schedule that includes:

■ The blade condition;

■ The pulley and pulley bearing wear; and the correct operation of:

■ Guides and thrust wheels;

■ Blade tensioning device;

■ Blade and pulley cleaning equipment;

■ Guards and safety devices.

Tool selection

Select the correct width of saw blade by measuring the smallest radius of any curve to be cut. Choose the widest blade that will cut this curve without bending as excessive blade twisting may cause the blade to break.

Choose a tooth pitch to suit the material thickness, i.e. the pitch should not exceed the depth of material being cut. The tooth form should also suit the material being sawn, i.e. standard tooth used for natural timber. If in doubt, follow the manufacturer's recommendations.

Tool handling

You should take care to avoid damaging the saw blade. When not in use, coil narrow band-saw blades into thirds and secure them. They should be stored in a safe dry place and transported in jigs. Check them before use for damaged teeth and cracks.

Machine operation

You should adjust the saw guides and attached adjustable guard as close to the work piece as possible before you start cutting and they should be kept in this position during cutting.

Cutting with a fence

Always use a fence for straight cutting to prevent the work piece rocking or sliding (see Figure 1). For shallow work, use a low position fence as this will allow you to adjust the blade guides and guard close to the work piece. It will also allow the safe removal of offcuts that are close to the blade by using a push stick.

When hand feeding against a fence, use a wooden guide block to exert an even pressure on the work piece. You should also use the push stick when feeding close to the blade (see Figure 1).

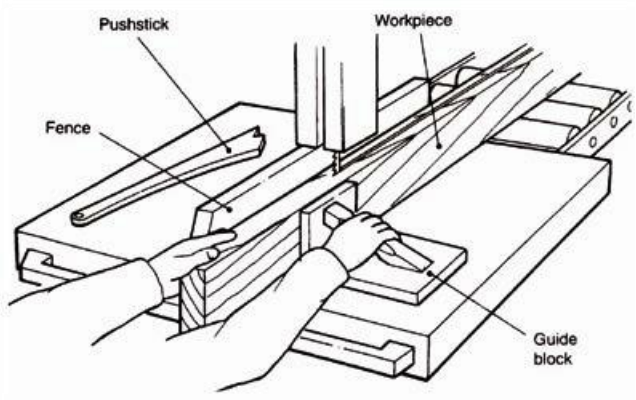

Figure 1 Straight cutting

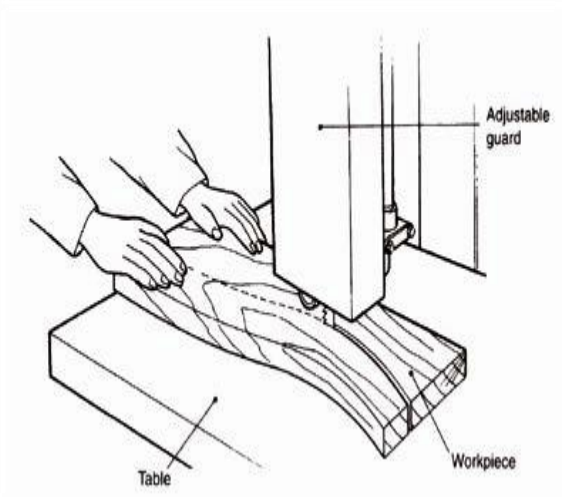

Figure 2 Handling shaped work on a narrow band saw

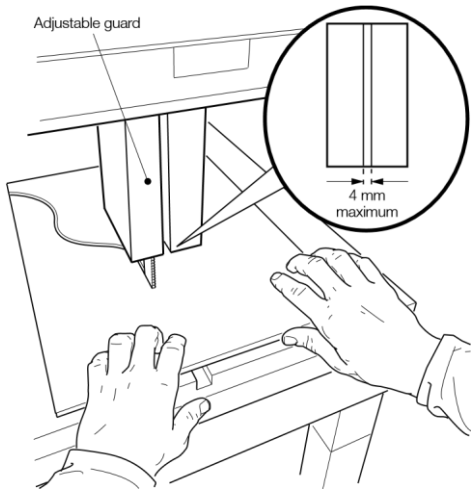

Figure 3 Freehand cutting

Cutting without a fence

Where it is not practicable to use a fence, feed the work piece forward evenly but without exerting excess pressure. Hold it firmly on the table to make sure that you have effective control during cutting. **Keep your hands in a safe position** (see Figure 2) by keeping them as far away from the blade as possible. If your hands have to go near to the blade place them on either side of it, not in line (see Figure 3).

Curved or irregular work

You can produce a variety of curved or irregular shapes without a template (see Figure 3). However, for repetitive work, a guide pin fixed in front of the blade used with a template improves safety as well as the speed of operation (see Figure 4).

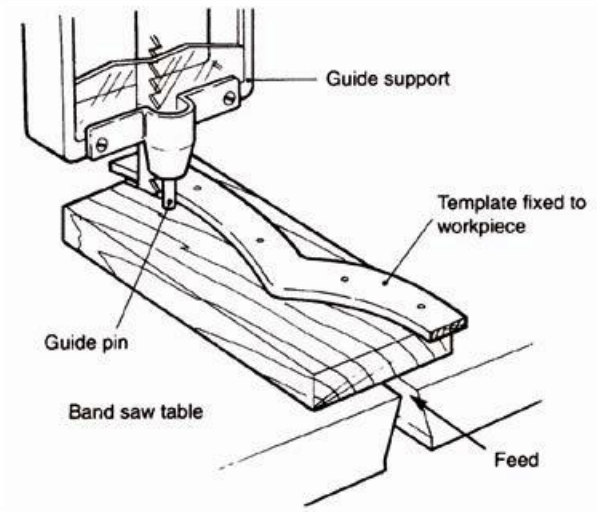

Figure 4 Cutting irregular shapes on a narrow band saw using a template and guide pin

Bevel cutting

Bevel cutting is usually done by tilting the table. This requires additional workpiece support, such as a fence, to prevent the workpiece falling from the table (see Figure 5). On machines with a fixed table or tiltable fence, a jig is necessary to provide support for the workpiece. Use a push stick at the end of the cut.

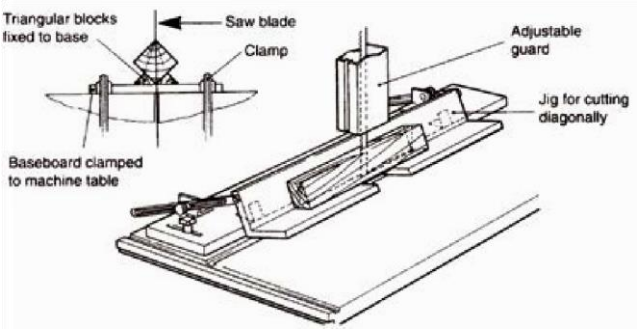

Figure 6 Diagonal cutting

Cutting tenons

You can cut simple tenons using a fence with a stop clamped to the table (see Figure 7). However, for complex tenons or repetitive work using jigs will be safer.

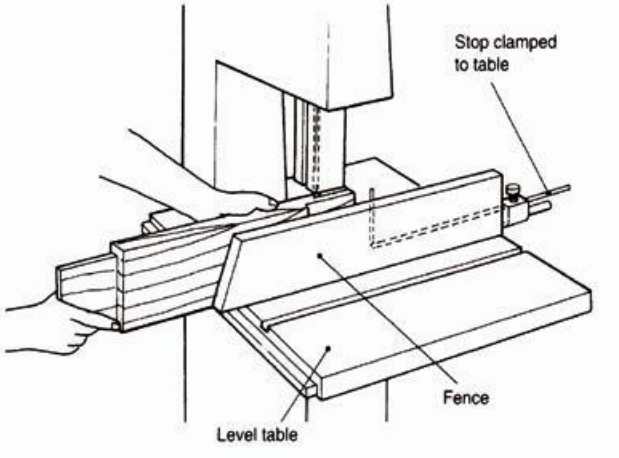

Figure 7 Cutting simple Tenons on a narrow band saw using a fence and back stop

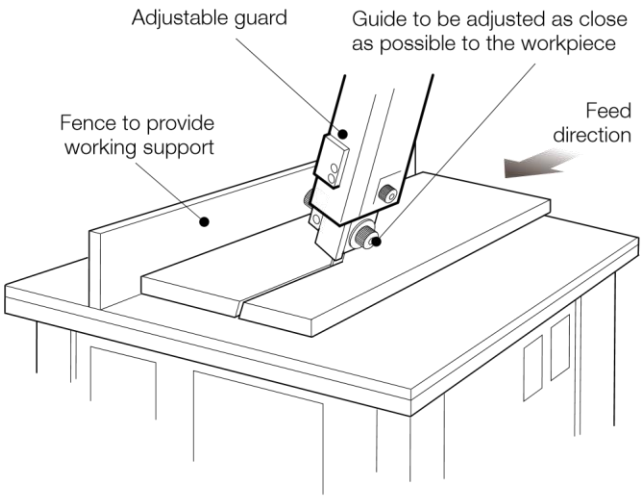

Figure 5 Bevel cutting using a tilting table

For a diagonal cut on square stock, feed the workpiece through a trough type of jig fixed to the table (see Figure 6).

Wedge cutting

You can cut small wedges safely using a wedge holder (see Figure 8).

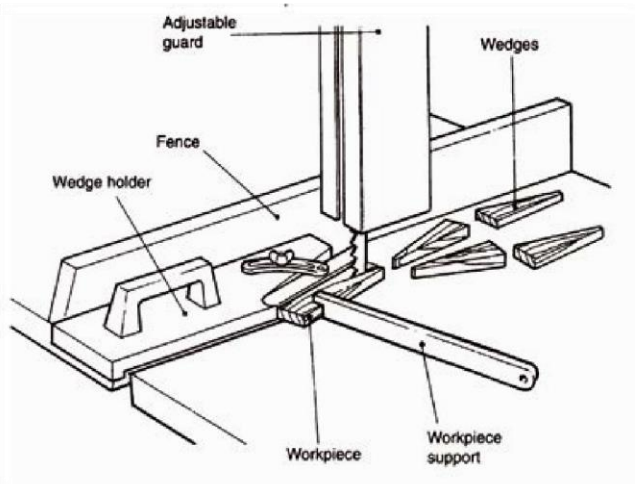

Figure 8 Wedge cutting

Circular work

A jig can also be used for cutting circular discs (see Figure 9). The work piece is placed centrally on the pivot, with one edge touching the saw blade, and rotated to produce a circular disc. You should start the cut on the end grain and feed the work piece slowly with even pressure.

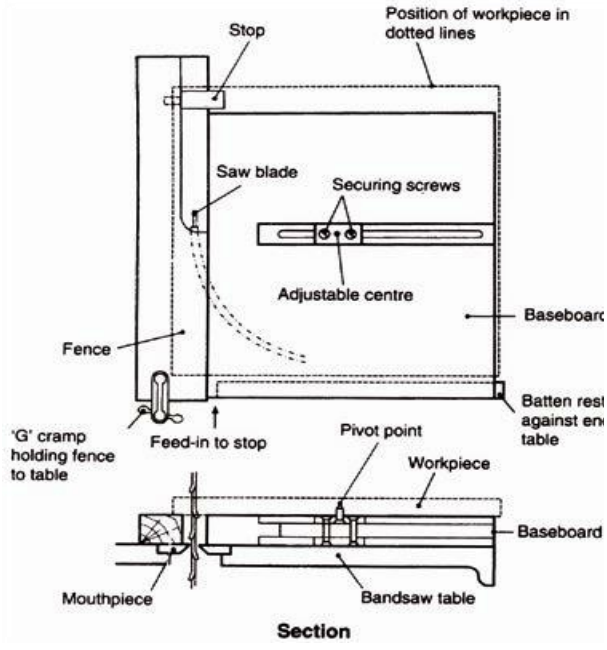

Figure 9 Cutting a circular disc

Crosscutting or ripping round stock

Hold round stock in a suitable jig or holder to prevent rotation caused by the cutting pressure. The blade should also be suitable for cross-cutting.

Work piece support

The table should support the whole work piece. Where a large work piece overhangs the table, use additional support such as extension tables or roller trestles at both the in-feed and out-feed. This is important as large unsupported work pieces tipping are a common cause of accidents.

References

1 *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 (as applied to woodworking machinery). Approved Code of Practice and guidance* L114 HSE 2014 www.hse.g.ov.uk/pubns/books/l114.htm

2 BS EN 1807 2013+A1:2009 *Safety of woodworking machines. Band sawing machines. Table band saws and band re-saws* British Standards Institution

3 HSE's risk management website: www.hse.g.ov.uk/risk

4 *Retrofitting braking to woodworking machines* Woodworking Information Sheet WIS38(rev1) HSE 2014 www.hse.g.ov.uk/pubns/wis38.htm

5 BS EN ISO 13857:2008 *Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs* British Standards Institution

6 *Wood dust: Controlling the risks* Woodworking Information Sheet WIS23(rev1) HSE 2012 www.hse.g.ov.uk/pubns/wis23.htm

Further information

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit www.hse.g.ov.uk/. You can view HSE guidance online and order priced publications from the website. HSE priced publications are also available from bookshops.

British Standards can be obtained in PDF or hard copy formats from BSI: http://shop.bsigroup.com or by contacting BSI Customer Services for hard copies only Tel: 020 8996 9001

email: cservices@bsigroup.com

Further reading

Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance L22 (Fourth edition) HSE 2014 www.hse.g.ov.uk/pubns/books/l22.htm

More information on narrow band saws, including videos illustrating correct working practices, can be found on HSE's woodworking website: www.hse.g.ov.uk/woodworking/bandsaw.htm

Further information for suppliers, installers and users of new and second-hand machinery can be found on HSE's Work equipment and machinery webpages: www.hse.g.ov.uk/work-equipment-machinery/index.htm.

This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory, unless specifically stated, and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance.

This document is available at: www.hse.g.ov.uk/pubns/wis31.pdf

Safe use of manually operated cross-cut

Sawing machines
HSE information sheet

Scope

This sheet gives information on cross-cut saws, where the blade is moved through the work piece by human effort to cut material to length.

The saws covered are horizontal stroking machines (travelling head, radial arm and pendulum) and down- stroking machines (chop saw).

Accident record

Saws are the main cause of accidents in the woodworking industry. In the majority of cases, accidents could have been prevented by providing appropriate training and supervision. Equally important is guarding to prevent access to the blade during normal operation and also during the rundown period.

Safeguarding the machines

Manufacturers must ensure that new machines are constructed to all relevant harmonised standards in accordance with the Supply of Machinery (Safety) Regulations 2008.

The supplier is responsible for ensuring that second hand machinery is safe to use. This is a requirement of section 6 of the Health and Safety at Work etc Act 1974.

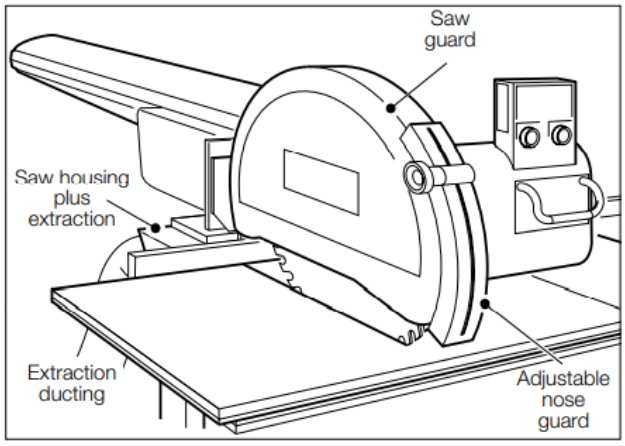

Figure 1 Travelling head machine

Horizontal stroking machines (travelling head, radial arm and pendulum crosscut saws)

Although different in design, the guarding principles are the same for the travelling head, radial arm and pendulum cross-cutting machines (see Figures 1, 2 and 3). This is to enclose the saw blade as much as possible for as long as possible.

All machines should be fitted with a fixed (hood) guard to enclose the upper part of the saw blade. This guard will extend down at least as far as the saw spindle.

Returns device

There should be no access to the saw blade when it is in the rest (behind the fence) position. On

older machines, this can be achieved by providing a saw housing into which the saw returns automatically. This can be by either a spring-assisted return or counter balance device. This return device will also prevent the risk of the saw unit travelling forward from its rest position. Where a return device is used, to prevent the risk of 'bounce back' towards the operator some form of impact absorption material may be required.

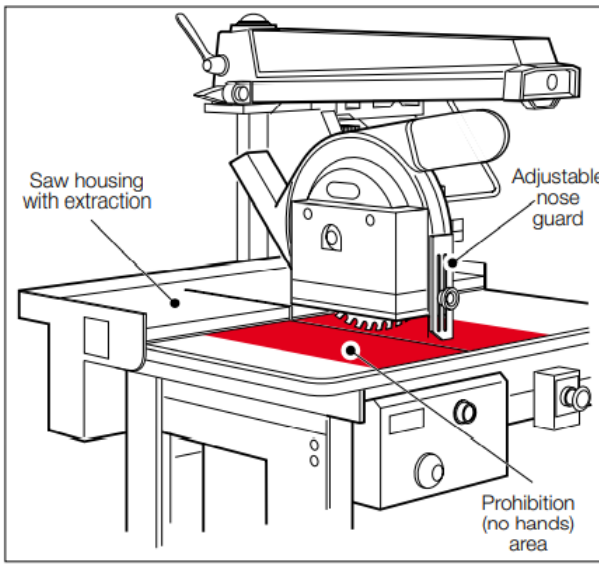

Figure 2 Radial arm machine

Braking

Where the saw does not return to a safe rest position, an efficient brake, DC injection or manual, that stops the saw within 10 seconds must be fitted. Serious consideration should be given to fitting DC braking, even with a safe rest position, if there is regular or continuous use of the saw.

Machines built to modern standards will in most cases have self-closing side guards which cover at least the outside edge of the saw teeth and will rise and fall during operation.

However, these guards do not provide protection against contact with the saw blade from the front of the machine. A nose guard should therefore be fitted and adjusted as close as possible to the material being cut; best practice is to within 12 mm of the work piece. The saw blade stroke should be set so that the nose guard does not extend beyond the front edge of the work table.

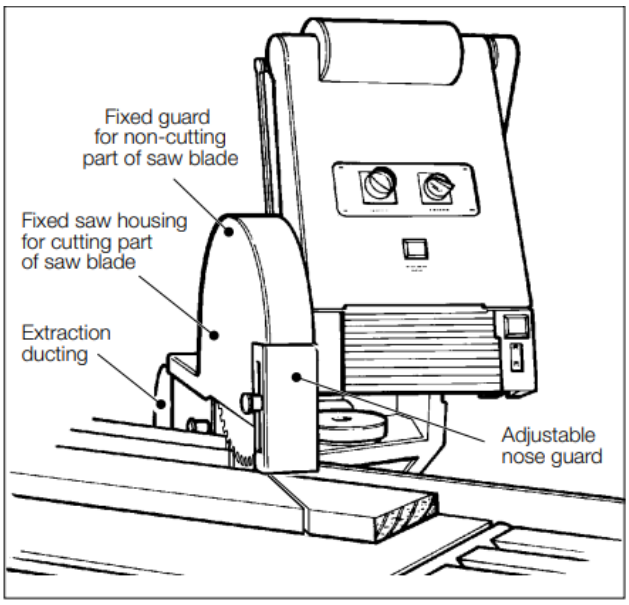

Figure 3 Typical pendulum machine

Fence and table

A fence should be fitted which is high enough to support the material being cut on either side of the cutting line. In most cases, the fence will need to be modified to allow the nose guard to be lowered when cutting thin materials (see Figure 4).

Adequate work piece support is required for all operations carried out. Long work pieces should be supported using extension tables or roller supports either side of the saw unit.

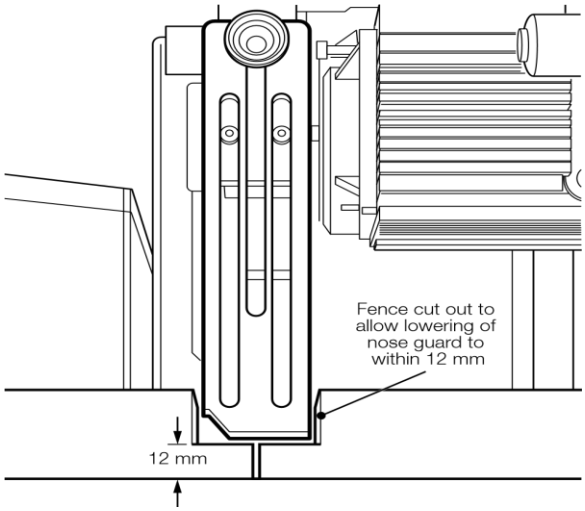

Figure 4 Fence cut out

Down-stroking machines (chop saws)

These are also known as snipper saws or mitre saws (see Figure 5). These machines move in a downward motion, through an arc, during their cutting action. Some machines may combine a horizontal movement and this should only be possible when the saw blade is lowered to the maximum depth of cut.

The upper part of the blade, like the horizontal stroking machines, should have a fixed guard which extends to at least the saw spindle. There is no access to the cutting part of the blade due to a self-closing guard. When the unit is lowered, this guard will retract to allow the cut. This guard will be locked in the closed position, with a release control on the operator's handle.

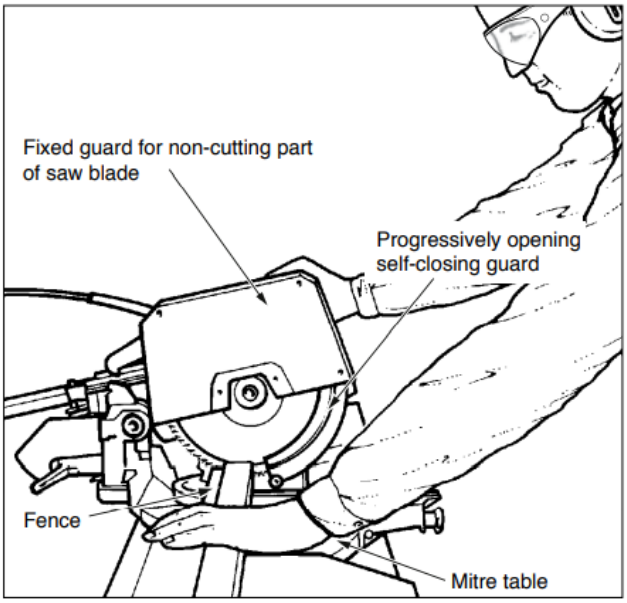

Figure 5 Down-stroking machine

Safe working practices

The immediate cutting area must extend the full width of the saw movement. Where the table does not meet this, an extension table should be fitted (see Figure 6).

It is good practice to mark the immediate cutting area of the table with a coloured prohibition area. This should ideally be 300 mm either side of the saw cut (Figure 6). The operator's hands should not enter this area. Small components and/or off-cuts should be removed using a push-stick. Also, reaching across the saw line should be avoided.

On chop saws, it is impracticable to apply the 300 mm either side. It is, therefore, acceptable to use the semi-circular area as the guide.

Timber positioning

Some timber will be naturally bowed. Figures 6 and 7 demonstrate how to position bowed timber.

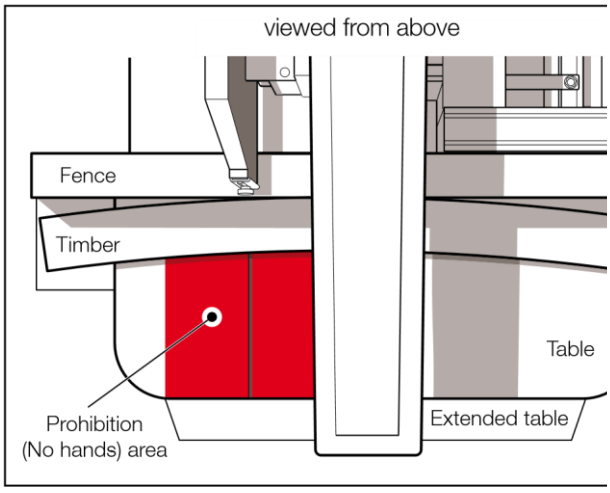

Figure 6 Bowed timber – rounded edge to the fence to prevent snatching

Restricted operations

Although a radial arm machine is capable of ripping material, this is classed as an extremely high-risk operation and, therefore, should not be carried out on this machine unless it is correctly safeguarded as per manufacturer's instructions. A more suitable machine is a circular rip saw bench.

Pointing of stakes. This is also a high-risk operation and an appropriate guide piece fastened to the table should be used.

Trenching. A suitable jig must be used which will safely and securely hold the component. Chip limitation tooling must also be used.

References and further reading

1 *Machinery – Guidance notes on the UK Regulations (September 2009)* URN 09/P86 Department for Business, Innovation & Skills (BIS)

Copies from www.bis.gov.uk/files/file52968.pdf

2 *Management of health and safety at work. Management of Health and Safety at Work Regulations 1999. Approved Code of Practice and guidance* L21 (Second edition) HSE Books 2000 ISBN 978 0 7176 2488 1

www.hse.g.ov.uk/pubns/books/l21.htm

3 *Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance* L22 (Third edition) HSE Books 2008 ISBN 978 0 7176 6295 1 www.hse.g.ov.uk/pubns/books/l22.htm

4 *Safe use of power-operated cross-cut saws* WIS35 HSE Books 2011 www.hse.g.ov.uk/pubns/wis35.pdf

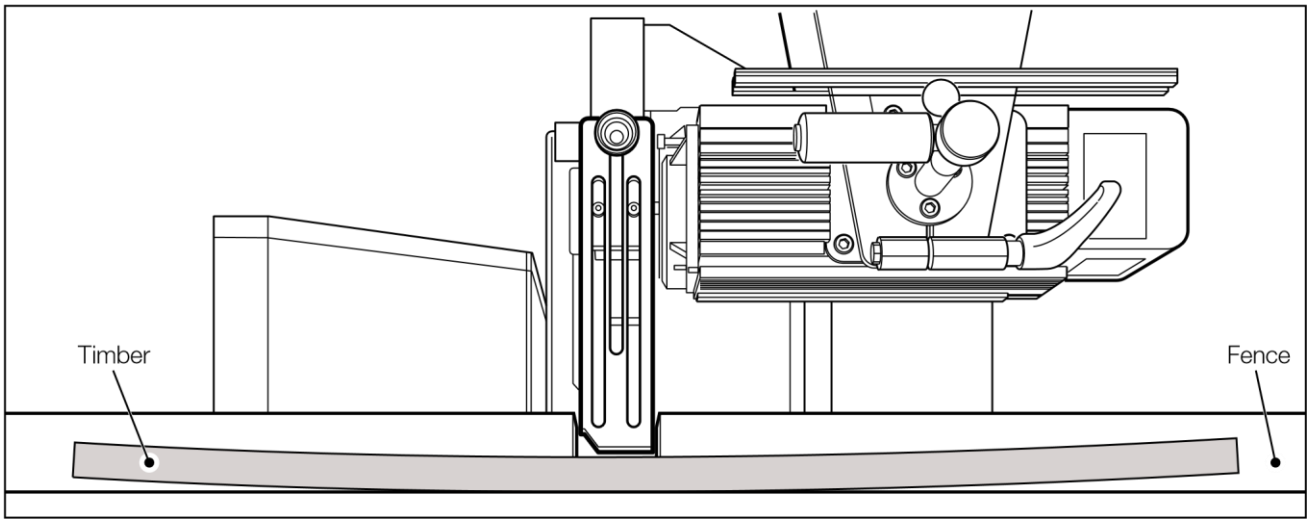

Figure 7 Bowed timber – rounded face down to prevent snatching

5 *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 as applied to woodworking machinery. Approved Code of Practice and guidance* L114 HSE Books 1998 ISBN 978 0 7176 1630 5

www.hse.g.ov.uk/pubns/books/l114.htm

Further information

Further information on health and safety for woodworking can be found on HSE's woodworking website: www.hse.g.ov.uk/woodworking/

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This information sheet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

This document is available at www.hse.g.ov.uk/pubns/wis36.pdf).

First published 06/11.

Tooling for use with hand-fed

woodworking machines

HSE information sheet

Introduction

This information sheet gives practical guidance to employers and operators on the selection of moulding and profiling tools for use on hand-fed woodworking machines. Safety aspects of circular saw blades, band saw blades and the tooling for planing/thickening machines are not covered here.

Accident history

Most accidents at woodworking machines are caused by the operator's hands or fingers making contact with the rotating cutters. If this happened with old style tooling, it tended to pull the hand into the cutters after contact was made. This resulted in severe finger and hand injuries, often resulting in amputations.

Limited cutter projection tooling, sometimes referred to as chip thickness limitation tooling, significantly reduces the severity of injury if a machine operator's fingers contact the rotating tool. They also reduce the risk of work piece kickback and the many other serious injuries that this can cause.

Old-style tooling often only had the cutters held in place by the friction produced by clamping bolts. Fatalities happened if the operator set the machine to run at too fast a speed, with the increase in centrifugal force causing bolts to stretch and the cutters to be ejected. Limited cutter projection tooling is designed to prevent the cutters from being ejected from the tool body as there are two means of securing the cutters, for example, serrations in the head and knife and a bolted clamping wedge (see 'Tool fixing').

Limited cutter projection tooling should be used in addition to the normal guards, protection appliances (jigs etc..) and safe working practices, **not as an alternative**.

Legal requirements

Limited cutter projection tooling should be designed and constructed to meet BS EN 847-1.[1] Key

legal requirements covering the supply, selection and use of tooling are contained in *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 as applied to woodworking machinery. Approved Code of Practice and guidance*.[2] Regulation 4 of the Provision and Use of Work Equipment Regulations (PUWER) requires work equipment to be constructed or adapted to be suitable, in respect of health and safety, for the purpose for which it is used or provided. When selecting suitable work equipment, employers should pay attention to the type of tool chosen and select tools within the range specified by the machine manufacturer.

On which machines do I have to use limited cutter projection tooling?

Where possible to fit them, **there has been a requirement to use limited cutter projection tooling on hand-fed machines** since 5 December 2003.[2] The term 'hand-fed' includes the use of demountable power feed units and hand-operated carriages on which the work piece is placed manually or clamped.

Limited cutter projection tooling can be used with:

- Vertical spindle moulders;
- Single-end tenoners;
- Rotary knife and copy lathes where the hazards of ejection and contact with the tool are not prevented by a system of fixed guards and/or interlocked movable guards and/or self-closing guards;
- Any other machine onto which a moulding tool can be fitted, e.g. if a moulding tool is fitted onto a circular saw, or a cross-cut saw then the tool should be of a limited cutter projection type.

How do I know if my tooling complies?

The simple answer is to get your supplier to confirm that it complies – all new tooling manufactured in accordance with BS EN 847-1 should be designed to comply. Sales literature and the information supplied with the tooling will declare whether a particular tool has been designed to this Standard. European health and safety standards for the design and manufacture of new woodworking machines require the machine manufacturer to specify in the instruction handbook that only tooling complying with BS EN 847-1 should be fitted to the machine.

New moulding/profiling tools for use on hand-fed machines should be permanently marked with a variety of information that will also help identify what type of tooling it is, including:

- The name/trademark of the manufacturer/supplier;
- The designed speed range;
- 'MAN', indicating hand feed;

and ■ The tool dimensions.

Most tools are also marked with an arrow which indicates the intended direction of rotation. Tools are not required to have the CE marking – when supplied separately from a machine they are not covered by the Supply of Machinery (Safety) Regulations 2008.

Are French (or slotted) spindles and slotted collars acceptable on vertical spindle moulding machines?

No, they should no longer be used as on this type of tooling there is no means of restricting the cutter projection. Also, the cutters cannot be mounted as safely as those designed to BS EN 847-1. Use limited cutter projection tooling instead because it is safer.

Limited cutter projection tooling

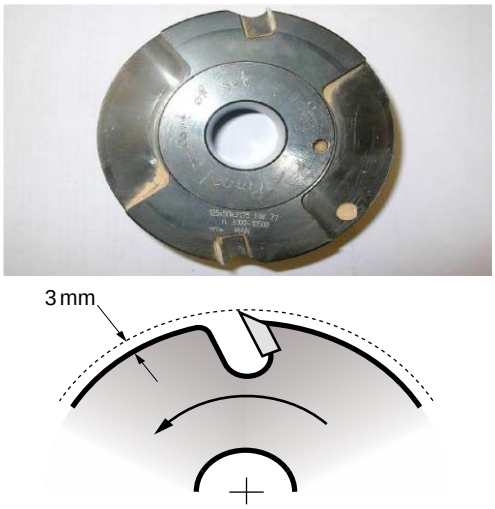
There are two types of limited cutter projection tooling, 'round form' and 'non-round form'. On **round form tools**, as the name suggests, the tool body has a circular shape at any cross-section perpendicular to the rotational axis of the tool. On this type of tool, limited cutter projection is achieved by restricting the projection of the cutter beyond either:

- The round profile of the tool body (see Figure 1);

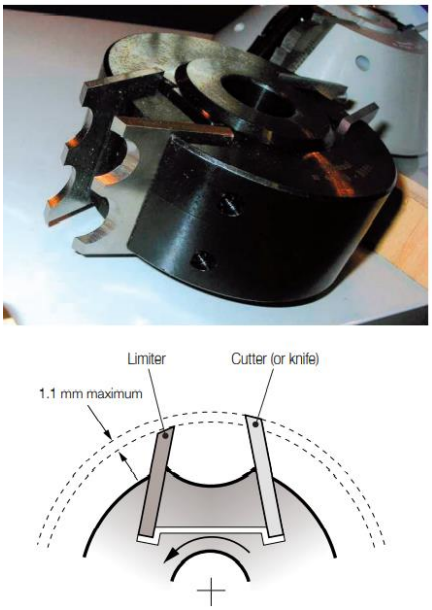
or

- A 'limiter' (also called a deflector or counter knife) which mirrors each cutter (see Figure 2).

With round form tools, the amount of cutter projection beyond the tool body should be limited to a maximum of 3 mm (see Figure 1). The exact figure will depend on a kickback test carried out by the tool manufacturer.[1] In many cases, the projection will be less than 3 mm. For further information, you should consult your tooling manufacturer or supplier.

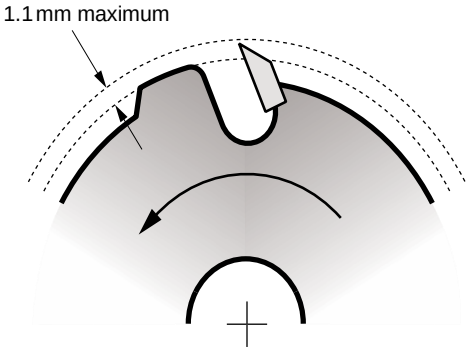


Figures 1a & 1b Round form tool with limited cutter projection



Figures 2a & 2b Use of a 'limiter' to achieve limited cutter projection

Where limiters are used, the amount of cutter projection beyond the corresponding limiter should be restricted to a maximum of 1.1 mm (see Figure 2). Exchangeable limiters can be mounted on the tool body, or the tool body can be shaped in such a way that it permanently incorporates the limiter (see Figure 3). However, this design will restrict the range of cutters that can be used on a particular tool body.



Figures 3a & 3b Tool body designed to permanently incorporate a limiter. Note: Figure 3a shows a tool also fitted with a spur, a cutter that operates on both the periphery and flank.

Non-round form tools should be designed in such a way that cutters project a maximum of 1.1 mm beyond the edge of the tool body or limiter (see Figure 4).

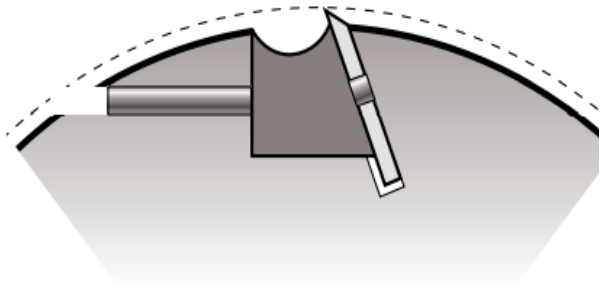


Figure 5a Locking pins

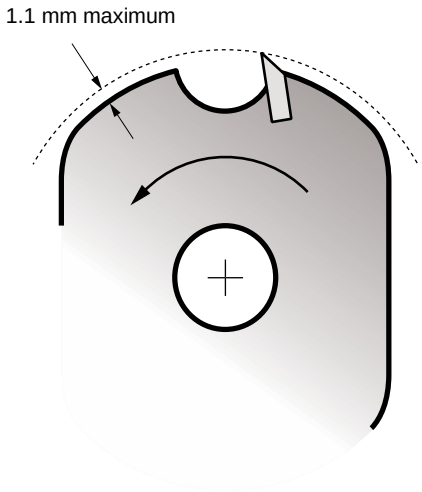


Figure 4 Example of a non-round form tool with limited cutter projection

Braking

Un-braked single-end Tenoning machines can have a run-down time of between two and five minutes. To reduce the risk of contact with the cutters and saw during run-down, single-end Tenoning machines should have been fitted with a braking device after 5 December 2003.[3,5] The braked run-down time should be less than ten seconds, but where the run-up time exceeds ten seconds it should be less than the run-up time but not exceed 30 seconds.

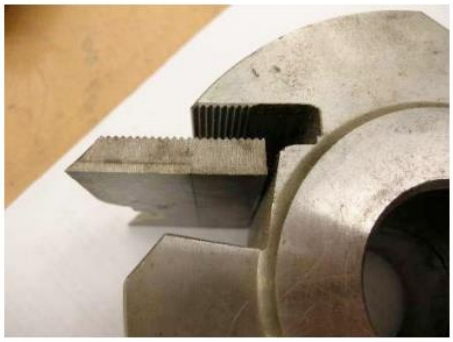
Tool fixing

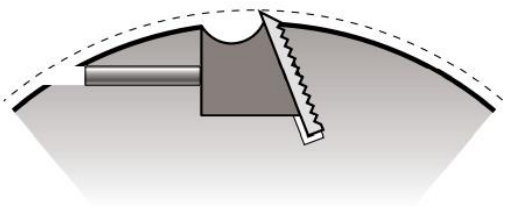
Detachable cutters and limiters should be of the correct thickness for the tool body in which they are used. Cutters and limiters should be mounted in such a way that they cannot be ejected, a problem which used to occur with old-style tooling. This is usually achieved by the use of either:

- Locking pins (see Figures 5a and 5b);
- Serrated-backed cutters (see Figures 6a and 6b); or
- 'key' or wedge-shaped cutters, i.e. that slot into a similarly shaped hole in the tool body and which cannot be ejected because the slot narrows towards the outer edge of the tool body (see Figure 7);

Example of tooling designs which reduce the risk of cutter ejection:

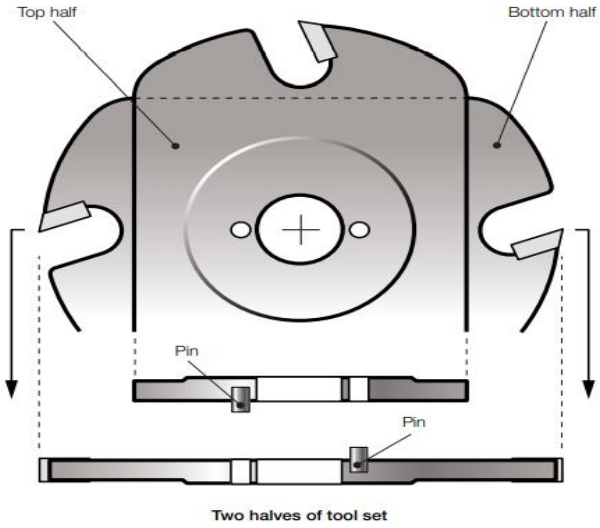
Figure 5b Locking pins





Figures 6a & 6b Serrated-backed cutter

Figure 7 Key or wedge-shaped cutter



Tool sets and stacked tools

Tools that belong to a tool set (or are part of a stacked tool), which do not in themselves meet the design requirements already described, should be designed in such a way as to prevent the parts being used individually, for example by using locating pins in the tools design (see Figures 8a and 8b).

Figures 8a & 8b Examples of suitably designed tool sets

Tool sharpening and maintenance

Any tool repairs should be carried out in accordance with the manufacturer's instructions – consult your supplier if in doubt. Anyone who repairs tools should be adequately trained and have knowledge of the design requirements, particularly BS EN 847-1, and the levels of safety to be achieved.

Are there any other benefits from using limited cutter projection tooling?

In addition to being safer to use, limited cutter projection tooling has the following benefits:

■The reduced depth produces a better finish, so less sanding is required, reducing the health risk and improving production.

■The old-style tooling required a lot more skill and time to set up correctly. Limited cutter projection tooling is simpler to set up and therefore reduces down time during changeover. Also, as it is more likely to be right first time, less timber is wasted. One head can also have several different profiles, which also reduces set up times.

■Chip limited tooling is much better balanced so there is less vibration when it runs. This has the following benefits:

– Less vibration means there will also be a reduction in noise levels. Noise levels will also be reduced if the tool body is made from aluminium, a feature of some limited cutter projection tools. Lighter aluminium bodies also reduce forces on the motor during braking as well as making the tools easier and safer to handle.

– Less vibration means that the tool cuts more efficiently so it can therefore have a three to four times longer tool life. There will also be an improved finish and less wear on the shaft and bearings of the machine.

References

1 BS EN 847-1:2013 *Tools for woodworking - safety requirements. Part 1: Milling tools, circular saw blades* British Standards Institution

2 *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 as applied to woodworking machinery. Approved Code of Practice and guidance* L114 HSE Books 1998 ISBN 978 0 7176 1630 5 www.hse.g.ov.uk/pubns/books/L114.htm

Further reading

Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance L22 (Third edition) HSE Books 2008 ISBN 978 0 7176 6295 1 www.hse.g.ov.uk/pubns/books/l22.htm

More information on woodworking machinery, tooling and other safety and health issues can be found on HSE's woodworking

website: www.hse.g.ov.uk/woodworking.htm

Information for suppliers, importers or hirers of equipment can be found on HSE's Work equipment and machinery

Website: www.hse.g.ov.uk/workequipment-machinery/supplier.htm

Further information

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This document is available at:

www.hse.g.ov.uk/pubns/wis37.htm

Single-end Tenoning machines

Safe working practices
HSE information sheet

Introduction

This information sheet contains practical guidance on safe working practices when using a single-ended Tenoning machine. This information is aimed at employers and others who have control of how single-ended Tenoning machines are used. Machine operators will also find this information of use.

Accident history

Severe accidents, including amputations are caused on single-end Tenoning machines by the operator making contact with the cutters or saw while:

- Checking if the local exhaust ventilation (LEV) was working, often during rundown;
- Setting and adjustment;
- Cleaning up or clearing blockages.

In all of these accidents, the cutters were found to have been still in motion. This was because:

- The machine had not been switched off;
- The machine had been switched off but the operator had not applied the brakes or not braked all of the spindles.

Training

It is important that the machine is fitted with the necessary safeguards and that machine operators are trained to use them and carry out the work they are expected to do safely. No one should be allowed to work at a woodworking machine unless they have demonstrated competence. It is advisable that competent operators are authorised in writing by a responsible person (director, senior manager etc.). This will then form part of the training records. Anyone who supervises the use of work equipment must also have received adequate training and both operators and supervisors must have access to information and, where appropriate, written instructions.[1] There should also be effective maintenance in place.

Legal requirements

Legal requirements covering the use of single-ended Tenoning machines are contained in *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 (as applied to woodworking machinery). Approved Code of Practice and guidance*.[1] This document gives practical advice on the safe use of woodworking machinery and covers the provision of information and training as well as aspects of guarding and maintenance (see also Further reading).

When buying a new single-end Tenoning machine, it should be supplied with a Declaration of Conformity and have a CE Mark. Designers and manufacturers must conform to the essential safety requirements of the Machinery Directive and associated European Free Trade Association (EFTA) regulations. One way of achieving this is by designing and

constructing the machine to meet BS EN 1218-1.[2] Cutter blocks should meet BS EN 847-1.[3]

Safeguarding of single-end Tenoning machines

Newer machines are provided with a high standard of guarding with access to the tools prevented by either:

■ A combination of fixed and interlocked guards, which together with the work piece and associated adjustable guards totally enclose or prevent access to the tools;

■ Guards that only partially enclose the tools but access is prevented by having additional design features (reach distances/gaps) that comply with BS EN ISO 13857;[4]

■ Power-operated or self-closing guards which make the tools inaccessible at all times except during the working and return stroke of the sliding table. With this option, deterring/impeding devices are also attached to the sliding table.

There are still a large number of older hand-fed, single-end Tenoning machines in use and the standard of guarding on many of these machines is often not very high. This is because of the way the machine operates and the type of work done, both of which make conventional guarding difficult. It is however 'reasonably practicable' to make modifications and improvements to their guarding which will reduce the risk of injury to operators and others.

Improve the guarding of the tools

The Tenoning and scribing head(s) should be enclosed to the greatest extent practicable using a combination of fixed and adjustable guards. This will keep the openings, which the work piece has to pass through, as small as possible. These can often be made 'in-house', see Figure 1.

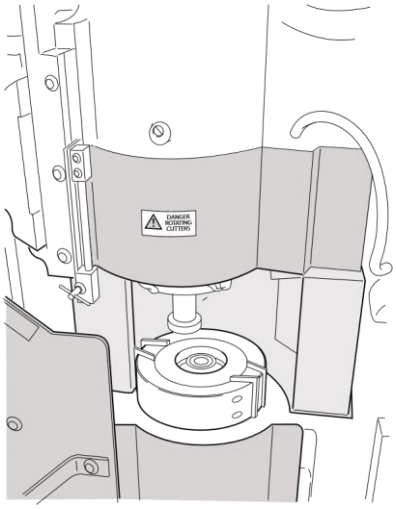

Figure 1 Additional adjustable guard, made by the duty holder, fitted to the scribing head of an older machine (guard shown in raised position). Any guards must be constructed from suitable materials and not increase the risk of injury.

The LEV hoods should form part of the fixed guarding arrangements so they can be positioned as close as possible to the cutting operation and be more effective in capturing the wood dust and chips, see 'Control of chips and dust'. Where possible, saws should have spring-loaded or gravity fall guards which enclose the saw blade, opening only when the work piece is being cut or withdrawn, see Figure 2.

It is also 'reasonably practicable' on most machines to fit vertical plates to the machining side of the sliding table (table guards). These are positioned in front of and behind the work piece and prevent the operator's hands or arms from coming into contact with the cutters as the work piece is taken through the machine, see Figure 3.

Figure 2 Additional gravity fall guard, made by the duty holder, fitted to the cut-off saw of an older machine

Restrict third party access

Unless access to the sides and rear of the machine is prevented by walls, other fixed structures or machines, erect an enclosure or suitable barrier to restrict third party access. You should however take care not to create any trapping points between new barriers or enclosures and the moving table or work piece. This is particularly important on machines with powered tables.

Tooling

Always use limited cutter projection tooling on handfed machines such as single-end Tenoning machines. This has been a legal requirement since 5 December 2003.[3] This type of tooling reduces the severity of injury should the operator's hand contact the tool. It also has other advantages such as reducing the tooling cutter change time and the smaller chips produced are less likely to cause blockages in the LEV. Limited cutter projection tooling should be designed to BS EN 847-1[3] and more detailed guidance can be found in Woodworking Information Sheet WIS37.[6]

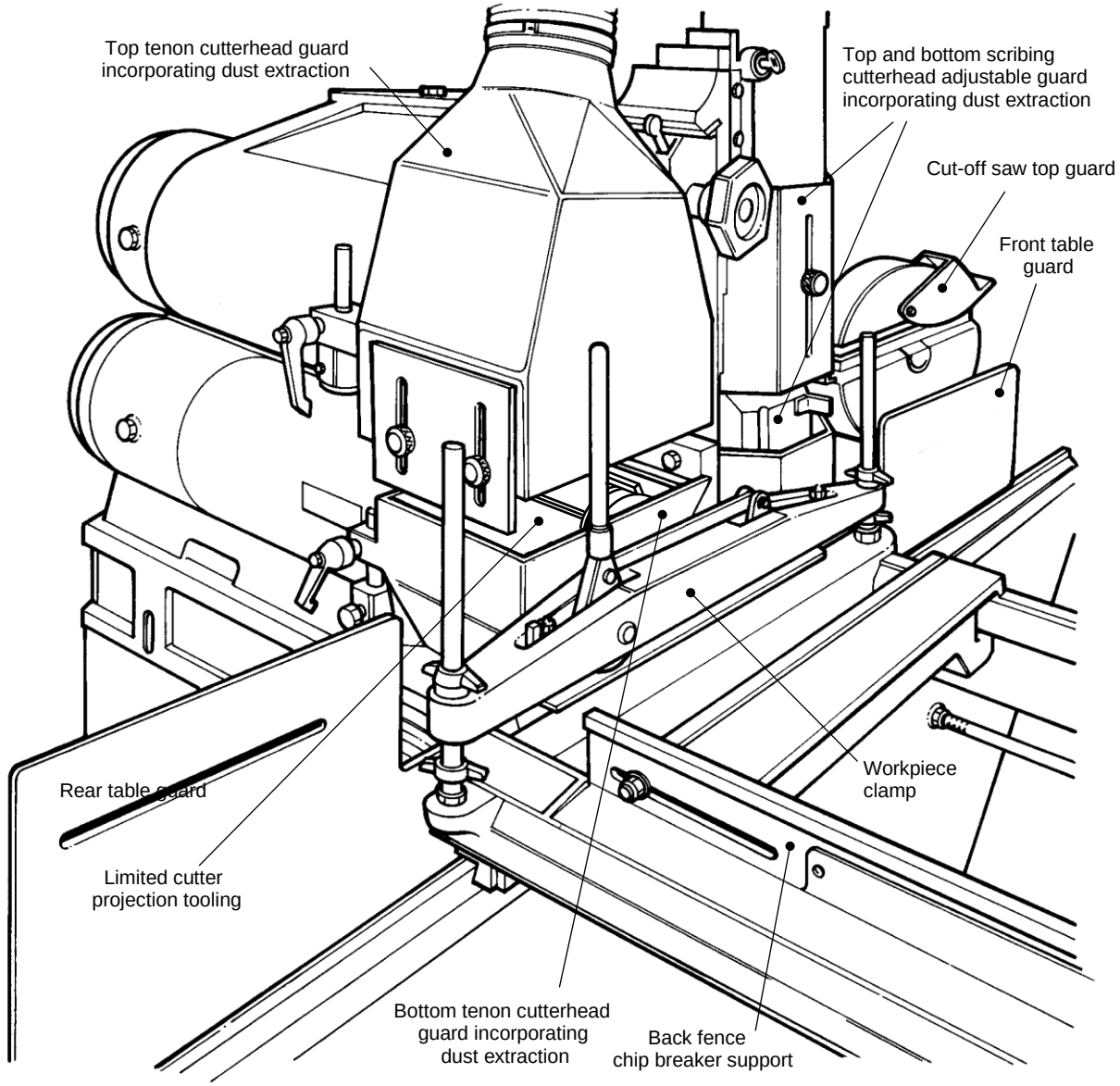

Figure 3 Older machine with additional safeguards fitted

Safe working practices

Clamping the work piece

All machines should be provided with work piece clamping as it is important that the work piece is held securely whilst being machined to prevent it from being ejected. On most machines, this is achieved by vertical or horizontal (side) clamps. Newer machines may have powered clamping but on older machines there are often hand-operated clamps. Where more than one work piece is to be machined at a time, additional clamps should be provided and used or other clamping arrangements made to ensure that all work pieces are held securely during the machining process.

With powered clamping, there is a risk of a crushing hazard between the clamping device and the work piece. This can be prevented by any of the following options:

■ Using two-stage clamping, with a clamping pressure not exceeding 50 x 10^3 Pa for one second, followed by full clamping pressure;

■ Reducing the gap between the clamp and the work piece to 6 mm or less by a manually

adjustable device and stroke limitation to a maximum of 10 mm or less;

■ Limit the clamp closing speed to 10 mm/second or less;

■ Guarding the clamp by a guard fixed to the clamping device that reduces the gap between the work piece and the guard to 6 mm or less. The maximum extension of the clamp outside the guard should not be more than 6 mm.

Any powered clamping should have a facility for releasing the clamp(s).

Use of fences, guides and work piece supports

There should be a fence on the sliding table against which the work piece is located during machining. It is important that the fence is properly secured and well maintained. Where there is a possibility of contact between the fence and the tools, then that part of the fence should be made out of light alloy, plastic, wood or wood-based material.

For integrated-fed machines there should be a chip breaker (anti-splinter device) provided. For hand-fed machines there should be a means for attaching the chip breaker, e.g. holes in the fence. Where there is any possibility of contact with the tools, the chip breaker should be made out of solid wood, chipboard, fibreboard, plywood or plastic.

The area around the machine

Control of chips and dust

The area around the machine should be kept free of loose chippings and off-cuts. The best way to control wood dust is to have fixed LEV that will effectively control the dust at source as it is produced. When cleaning up, use vacuum equipment that meets at least the dust class M (medium hazard) classification. Do not use compressed airlines or hand brushing, particularly on clothing, as these will just create dust clouds and redistribute the dust. For more information on the health and safety risks from wood dust and how they can be controlled see Woodworking Information Sheet WIS23.[7]

Work pieces

To avoid falling objects and tripping hazards, all work pieces should be carefully stacked and placed in convenient locations. This should allow safe and easy feeding to and delivery from the machine.

Lighting

Good general lighting around the machine will also reduce tripping hazards as well as assist the operator during the machining process. If necessary, provide additional local lighting to illuminate the cutting areas.

References

1 *Safe use of woodworking machinery. Provision and Use of Work Equipment Regulations 1998 (as applied to woodworking machinery). Approved Code of Practice and guidance* L114 (Second edition) HSE Books 2014

www.hse.g.ov.uk/pubns/books/l114.htm

2 BS EN 1218-1:1999+A1:2009 *Safety of woodworking machines. Tenoning machines. Single end Tenoning machines with sliding table* British Standards Institution

3 BS EN 847-1:2013 *Tools for woodworking. Safety requirements. Milling tools, circular saw blades* British Standards Institution

4 BS EN ISO 13857:2008 *Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs* British Standards Institution

5 *Retrofitting woodworking machine brakes* Woodworking Information Sheet WIS38(rev1) HSE 2013 www.hse.g.ov.uk/woodworking/wis.htm

6 *Tooling for use with hand-fed woodworking machines* Woodworking Information Sheet WIS37(rev1) HSE 2013 www.hse.g.ov.uk/woodworking/wis.htm

7 *Wood dust: Controlling the risks* Woodworking Information Sheet WIS23(rev1) HSE 2012 www.hse.g.ov.uk/woodworking/wis.htm

Further reading

Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance L22 (Fourth edition) HSE Books 2014

www.hse.g.ov.uk/pubns/books/l22.htm

More examples of fitting additional guarding on single-ended Tenoning machines can be found on HSE's woodworking

website: www.hse.g.ov.uk/woodworking/singleTenon.htm

Further information for suppliers, installers and users of new and second-hand machinery can be found on HSE's work equipment and machinery webpages: www.hse.g.ov.uk/work-equipmentmachinery/index.htm

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