Bamboo Product Processing

Level I

Based on November 2021, Version 1 Occupational standard

Module Title: - Producing joint

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Contents

LG #15	LO #1-Prepare for work
Instruction sheet	

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Workplace health and safety requirements
- Obtaining and confirming drawings and work instructions
- Selecting materials, tools, equipment, and machinery
- Planning application sequence

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Observe workplace health and safety requirements, including personal protection needs throughout the work.
- Obtain and confirm work instructions and drawings
- Make ready required materials, tools, equipment and machineries
- Plan application sequence.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet – 1	Workplace health and safety requirements

1.1 Workplace health and safety

Occupational Health and Safety is including Workplace health and safety requirements may include: OHS legislation, material safety management systems, hazardous and dangerous goods codes and local safe operating procedures or equivalent.

- **Safety**

  Safety is the first essential requirement and every personnel must learn the safety measures even before he starts working on a hand tools. Safety is an attitude, a form of mind of worker. If the attitude of worker towards safety is good and he is safety conscious, then he himself will develop the safe working habits. Before you can use tools or attempt practical work in a workshop you must understand basic safety rules. These rules will help keep you and others safe in the workshop.

- **Occupational safety and health**

  Occupational safety and health is concerned with preserving and protecting human and facility resources in the workplace. It involves more than first aid activities and is far-reaching in both scope and practice. Occupational safety and health involves helping people by preventing them from being injured or becoming ill due to hazards in their workplaces

  The objective work place safety is to protect every workingman against the dangers of injury, sickness or death through safe and healthful working conditions, thereby assuring the conservation of valuable manpower resources and the prevention of loss or damage to lives and properties, consistent with national development goals and with the State's commitment for the total development of every worker as a complete human being.

- **Safety equipment**

Safety equipment is for you. It will protect you from injury and may possibly save your life. Some of the more common types of safety equipment for your personal protection follow.

Figure 1 personal safety equipment

- ✓ **Safety Shoes**

Protect feet and prevent injury or loss of toes.

- ✓ **Goggle**

Eye protection is necessary because of hazards caused by infrared and ultraviolet radiation, or by flying objects such as sparks, globules of molten metal, or chipped concrete and wood, etc. These hazards are always present during welding, cutting, soldering, chipping, grinding, and a variety of other operations. It is absolutely necessary for you to use eye protection devices such as helmets, hand shields, and goggles during eye-hazard operations. Appropriate use of goggles will limit eye hazards Protection

- ✓ **Helmets**

Also known as hard hats come in a variety of shapes. They may be made of tough polyethylene or polycarbonate, one of the toughest hat materials yet developed. When falling objects strike the hats, the shock absorbing suspension capabilities minimize injuries.

- ✓ **Gloves**

Use gloves whenever you are required to handle rough, scaly, or splintery objects.

- ✓ **Hearing protection**

Isa must when working with or around certain types of power tools? Some tools are capable of producing dangerously high noise levels which, if ignored, can result in serious hearing loss or injury. Use the hearing protection regular earing protection

- Safety is a precaution to avoid accident.
- Care is a technique of properly handling tools, equipment's & materials.

Safety rule of hand tools

1.2 Workplace health and safety requirements

1.2.1 General Safety requirements on tools and equipment

- In bamboo work, it is important to learn the safe way of doing everything.
- If you do not care about safety, you will hurt not only yourself but other people also.
- It is important to listen carefully when the instructor is telling what to do and how to do it.
- It is also necessary to read and understand carefully about general safety on hand tools.
- Each time you learn to use a new tool, you must learn how to use it in a safe way.
- The following are the safety rules that you should remember and follow when you are learning bench wood work. These are important in all wood workshops.
- Hold the tool in the correct way when you are using it
- Be carefully not to hurt your back when you lift heavy things

Self-Check	Written Test

Directions: Answer all the questions listed below.

1. All tools and equipment are safe to use at any conditions
   A. True C. Not sure
   B. False D. B and C
2. Before starting work, what action should you accomplish first?
   A. Notify the supervisor B. Inspect your tools C. Insert hearing protection
   D. Operate the tool on a test item
3. Who should you notify for an unsafe condition?
   A. Supervisor C. Division officer
   B. Safety officer D. Commanding officer
4. What equipment can you operate?
   A. Any tool in the shop C. The tool type you are authorized to operate
   B. Any tool in the portable toolbox D. The tools needed for maintenance only
5. What tool habit states a tool is useless if you cannot find it?
   A. Keep your tool set complete B. Keep each tool in its proper place
   C. Keep your tools within easy reach D. Keep your tools in good condition

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

- You can ask your teacher for the copy of the correct answers after you try by yourself.

Information Sheet – 2	Obtaining and confirming drawings and work instructio

2.1 Obtaining and confirming drawings

Purpose of read and interpret job specifications is known to be one of the basic languages of technology, namely math, science and drawing. Through this application a technology task can be performed correctly. Examples of it is the schematic diagram of a circuit for electronics technician & electrician, detailed plan of an object for carpenters and machinist, technical and furniture plans for carpenters and construction workers e.t.c.

2.2 Confirming drawing

A component or part drawing is termed asa production drawing, if it facilities its manufacture. It is an authorized document to produce the component in the shop floor.

It furnishes all dimensions, limits and special finishing processes such as heat treatment, grinding, etc. in addition to the material used. It should also mention the number of parts that are required for making of the assembled unit, of which the part is a member.

Production drawing of a component should also indicate the sub or main assembly where it will be assembled. It is necessary to prepare the production drawing of each component on a separate sheet, since a craftsman will ordinarily make one component at a time. However, in some cases, the drawings of related components may also appear on the same sheet.

Work Instructions are documents that clearly and precisely describe the correct way to perform certain tasks that may cause inconvenience or damage if not done in the established manner. That is, describe, dictate or stipulate the steps that must be followed to correctly perform any specific activity or work. The work instructions are mainly focused on explaining how a specific activity is going to be carried out, and they are mandatory**.** The work instructions are used to describe a specific operation usually associated with a job.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: True or False Questions

1. Obtaining and reading drawing is a part of production.
2. Drawing consists all detail information about work.
3. Work instructions are clear documents about work.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

- You can ask your teacher for the copy of the correct answers after you try by yourself.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

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

Information Sheet – 3 Selecting materials, tools, equipment, and machinery

3.1 Selecting materials (culm)

The selection of bamboo is very important for making high quality products. The main criteria for selecting bamboo are Culm size, age and the growing environment. The bamboo raw material required depends on the intended application and characteristics of the product that will be manufactured. For example, culms that are 3-4 years old can be used for furniture making and culms younger than 1 year old, can be used as finishing strips for weaving because they have soft and flexible fibers.

Figure 2 selecting and sorting poles

3.2 selecting tools, equipment and machineries

3.2.1 Tools and equipment for work

There are various tools used for working with bamboo especially for making different furniture. Some of the tools used are given below. These tools are required for preparing and making bamboo furniture the poles for furniture making.

- **Power tools and machines**
  - ✓ Bench drill
  - ✓ Portable drill
  - ✓ Miter (cut off) saw
  - ✓ Portable grinder
- **Boring tools and bits**
  - ✓ Gouge chisel
  - ✓ Flat chisel
- **Cutting tools**
  - ✓ Hand saw
  - ✓ Bolo/ matchete
- **Other tools and equipment**
  - ✓ Workbench with V-block
  - ✓ Electric **solder or LPG torch**
  - ✓ Wrench
  - ✓ Screw drivers
- **Marking and measuring tools**
  - ✓ Diameter gauge
  - ✓ Meter tape
  - ✓ Pencil
  - ✓ Tri-square

1. **Caliper: -** Used to measure the inner and outer dimensions of various materials and pipes.

Figure 4 Venire Caliper

1. **Measuring tape:-**Used to measure longer length in various materials.

Figure 5 Measuring Tape

2. **Cross cut saw: -**Used to cut wood/bamboo based material along or across the grains.

Figure 6 Hand Saw

3. **Bolo (Scrapper): -**Used to scrap the knots and to remove branches of bamboo.

Figure 7 Scrapper

4. **Pole cutter: -** Used for cutting the bamboo pole or wood planks.

Figure 8 Saber saw

5. **Portable drill: -**is a hand-supported, power-driven tool that used to **drill** or bore different diameter and depth by using different types of drill bits.

Figure 9 portable drill

6. **Miter saw (cut off saw):-** is used to cut bamboo pole with required length across the grain
7. **Drill press: -** is a type of boring machine used to drill holes in different diameter by using drill bits.
8. **Portable grinder:** - is a type of power tool used to remove impurities and to smooth bamboo parts.

9. **Chisels and knives**:- used to cut bamboo pole in different shapes during bamboo joint making

Figure 10 chisels and knives

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Multiple choice

1. What criteria can we use to select bamboo pole?
   A. Culm size
   B. Culm age
   C. Growing environment
   D. all
2. For furniture production the age of bamboo preferred to be?
   A. < 1 year old
   B. 3 – 5 years
   C. 5 – 7 years
   D. > 10 years

3. Which tool is used to measure inner and outer diameter and wall thickness of culm?

A. Tri square C. Tape rule
B. Caliper D. Pencil

Matching Questions

Column A	column B
1. Bolo/ matchete	A, to cut holes on culm surface
2. Gouge chisel	B, used to scrap
3. Miter (cut off) saw	D, used to cross cut culm
4. Portable grinder	E, used to sad or remove impurities
5. Caliper	F, to measure inner and outer diameter
6. Tri-square	G, to measure angles of joints

Answer Sheet

Score = _____
Rating: _____

Name: _____ **Date:** _____

- **You can ask your teacher for the copy of the correct answers after you try by yourself.**

Information sheet -4.	Planning application sequence

4.1 Work plan

A work plan is a written document designed to streamline a project. The purpose is to create a visual reference for the goal, objectives, tasks and team members who are responsible for each area. Every member of your team should be updated based on progress and current status. Without clear goals and objectives, team members or trainees blindly work on tasks without purpose.

The first thing a work plan does is to define the goal of the project and the key objectives that the project will achieve. With these items defined, workers are able to perform work tasks toward goal achievement. If you have a complex project, you can create your own custom work plan. When you are clear about your strategy and what you need to be successful, a work plan template can save time, as you will plug in tasks, team members, objectives and timelines.

A work plan includes:

- Setting goals and objectives
- Establishing team responsibilities
- Setting project timelines
- Establishing a budget

- **Developing a work plan**

Set goals and objectives

The first step to creating a work plan is to set clear goals and objectives. Your goals should focus on the big picture, and the objectives should be specific and tangible. For example, if you are launching a new product, the goal may be to drive 50,000 people to the website in the next 12 months. An objective for that goal could be to launch a new social media campaign.

Establish team responsibilities

Once you have identified the objectives, assign team members to drive those initiatives. If you designate a team to accomplish individual objectives, assign a leader to keep the team on track. If the project is large and complex with many teams, assign hierarchy levels. Here, a project manager could oversee multiple team leaders, meeting with only those individuals and focusing on the overall progress to keep a project running according to schedule.

Set project timelines

Timelines are essential for keeping team members on task and expenses down. If you have a set amount of time to achieve your goal, you could change strategy more quickly if you see an opportunity to use a more effective approach.

Consider using the guidelines for SMART goals to create your work plan. SMART stands for:

Specific: Your goals, objectives and action steps should be clear and specific.

Measurable: It should be easily apparent when your goal has been accomplished.

Attainable: Your goals and objectives should be something your team can realistically accomplish within the designated time frame.

Relevant: The goal, objectives and tasks should be aligned with your values and long-term goals.

Time-based: Your plan should have a realistic end date that allows you to prioritize your time.

Establish a budget

Budgeting must happen at the end of this process, as part of the plan may include getting quotes from third-party vendors. The budget should break down the costs and assign different tasks to the individual teams. Each time a team reaches a new milestone or accomplishes an objective, you will be able to review your expenses and determine if the team is on budget. If a team or a task isn't within the budget, you might reallocate resources from other areas or determine if financial resources can increase.

- **Steps to Make a Work Plan**

1. Identify the Project Name, Purpose and General Timeline. ...
2. Put Your Work Plan into Context. ...
3. Establish Your Goals and Objectives. ...
4. Define and Coordinate Your Resources. ...
5. Understand Your Constraints. ...
6. Discuss Risks and Accountability.

4.1 Work plan template

Work plan templates are usually made for projects to make them more organized and efficient. They should display all the activities and tasks which are involved in a project, who is assigned to each activity and task and when the tasks are supposed to be completed. Usually, these plans are made as part of the requirements when submitting a proposal for a project. Once the project has been approved and has begun, the plan would then serve as a tool to keep track of the project and check if there are no delays

Objectives	Activities	Results	Duration	Week1/month1Year1							
				M	T	W	T	F	S		
Objective 1											
Objective 2											

Table 1 sample work plan template

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Answer the following questions.

1. What is work plan?
2. Write 5 steps to develop work plan?
3. Define SMART work plan?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

- You can ask your teacher for the copy of the correct answers after you try by yourself.

LG #16	LO #2- Prepare bamboo pole

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Selecting and sorting bamboo poles
- Scraping bamboo poles

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Select bamboo poles according to job specification and design requirements.
- Sort selected poles by age and diameter.
- Scrap selected bamboo poles.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the "Self-checks" which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to "Operation sheets
7. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
8. If your performance is satisfactory proceed to the next learning guide,

Information Sheet 1- Selecting and sorting bamboo poles

1.1 Selecting bamboo pole for furniture joint production.

Select culms that are 3-4 years old for making bamboo furniture joint as they have medium diameter (3 cm) and thick walls least 5 mm. Thick walls provide strength and a higher tolerance for nailing and drilling. The strongest poles come from plants that have 3 to 5-year old culms.

Select middle or small sized bamboo species, with straight and upright steam, small tapering, and small nodes; for furniture frame work processing, the bamboo culms should have comparatively thicker walls. Bamboo poles used in furniture production should be straightened for accurate joinery, ease in assembly and quality final product.

Figure 1 bamboo culm

Depending on the design of the product, list the various components needed along with the accurate measurements. Mostly the bottom portion of bamboo culms is used for structural components (front legs and back legs), and depending on strength and design requirements, other parts of bamboo can be used as supporting frames, seat support, slats etc.

- **Drying bamboo poles**

Green bamboo poles should not be used in construction. Since green bamboos are subject to shrinkage, joints and terminals may loosen after just a few weeks. Green bamboo is also more attractive to insects and microorganisms, than dry bamboo.

✓ Identifying dried bamboo poles?

The most common way to dry bamboo for commercial purposes is "air drying". Once the bamboo poles are harvested and chemically treated, all poles should be stacked and stored under cover.

Figure 2 bamboo poles air drying

- **Sorting bamboo pole**

Sort and classify the culms based on their size, diameter and quality. Bamboo poles, once cured and dried, can be used for many projects indoors and outdoors.

Figure 3 sorted bamboo poles

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Answer the following questions

1. For joint work the wall thickness of culm is at least ……..and straight.
2. Based on what criteria we sort and stack bamboo culm?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

- You can ask your teacher for the copy of the correct answers after you try by yourself.

Information Sheet 2 - Scraping bamboo poles

2.1. Scraping culm

Scraping is the process of removing the outermost skin of the bamboo while the use of a special tool called the bamboo scraper. Scraping however, may be done with a bolo.

Figure 3 culm scraping

You can also remove the knot portion using hand planer or machine (angle grinder) to smoothen out the surface. Then, using Curved knife or scrapper scraps the outer skin of bamboo pole (similar to scrubbing). This is best achieved when done manually. Common scraping tools are different types of knives, bolo and scraper. See the figure below.

Figure 4 culm scraping tools planner, bolo and scraping knife respectively

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

- ✓ What is scraping?
- ✓ List scraping tools?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

- ➢ You can ask your teacher for the copy of the correct answers after you try by yourself.

Operation sheet 1– techniques of preparing culm

1.1 tools and equipment

- PPE
- Scraping bolo
- Tape meter
- Hand saw
- Sand paper
- Work bench
- Pencil
- Bamboo culm

1.2 techniques preparing bamboo culm

1. wear proper PPE
2. Scrap by removing the outermost skin with bolo.

Figure 5 scraping

3. Mark and cut a bamboo culm with a crosscut saw across the grain.

Figure 6 cross cuttin

4. Sand after cross cut by sand paper

Figure 7 sanding

5. Mark a straight reference line on the entire length of component using straightened bamboo slat or meter tape or wooden ruler to make any required operation

Figure 7 marking

LA TEST	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **3** hour. The project is expected from each student to do it.

- **Prepare given bamboo culm**

Task 1 perform proper scraping

Task 2 sand and mark the culm

LG #17	LO #3- Produce joints

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Identifying components of joints
- Producing types of joints
- Using fastening material

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Identify component of joints according to drawing and design specifications
- Produce different types of joints by using appropriate tool or equipment according to the design specifications
- Use appropriate fastening materials according to the design specifications

Learning Instructions:

- Read the specific objectives of this Learning Guide.
- Follow the instructions described below.
- Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
- Accomplish the "Self-checks" which are placed following all information sheets.
- Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
- If you earned a satisfactory evaluation proceed to "Operation sheets
- Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
- If your performance is satisfactory proceed to the next learning guide,

Information Sheet 1- Identifying components of joints

1. Introduction

Joinery is a part of wood and bamboo working that involves joining pieces of wood, bamboo or lumber, to produce more complex items. Some wood joints employ fasteners, bindings, or adhesives, while others use only wood elements. The characteristics of wooden joints - strength, flexibility, toughness, appearance, etc

Joint is junction of two or more members of bamboo pieces. Joinery, or the making of bamboo joints, is one of the principal functions of the carpenter and cabinetmaker. Bamboo, being a natural material, is not uniform in quality, and moisture, present in the culm during growth, is uneven in cut culm. Bamboo used for furniture is subject to movement caused by changes in its moisture content. Though such movement is frequently quite small and accurately predictable, it remains a critical consideration in joint design. Because bamboo has been used as a furniture and building material for centuries throughout the world, the designs of most joints were perfected hundreds of years ago and have changed little since that time.

1.1 Identifying components of joints

In bamboo joint work, using bamboo nodes is very important. Bamboo columns or better to have a node at **both ends** (or as close as possible towards the ends) it helps the joint having more strength.

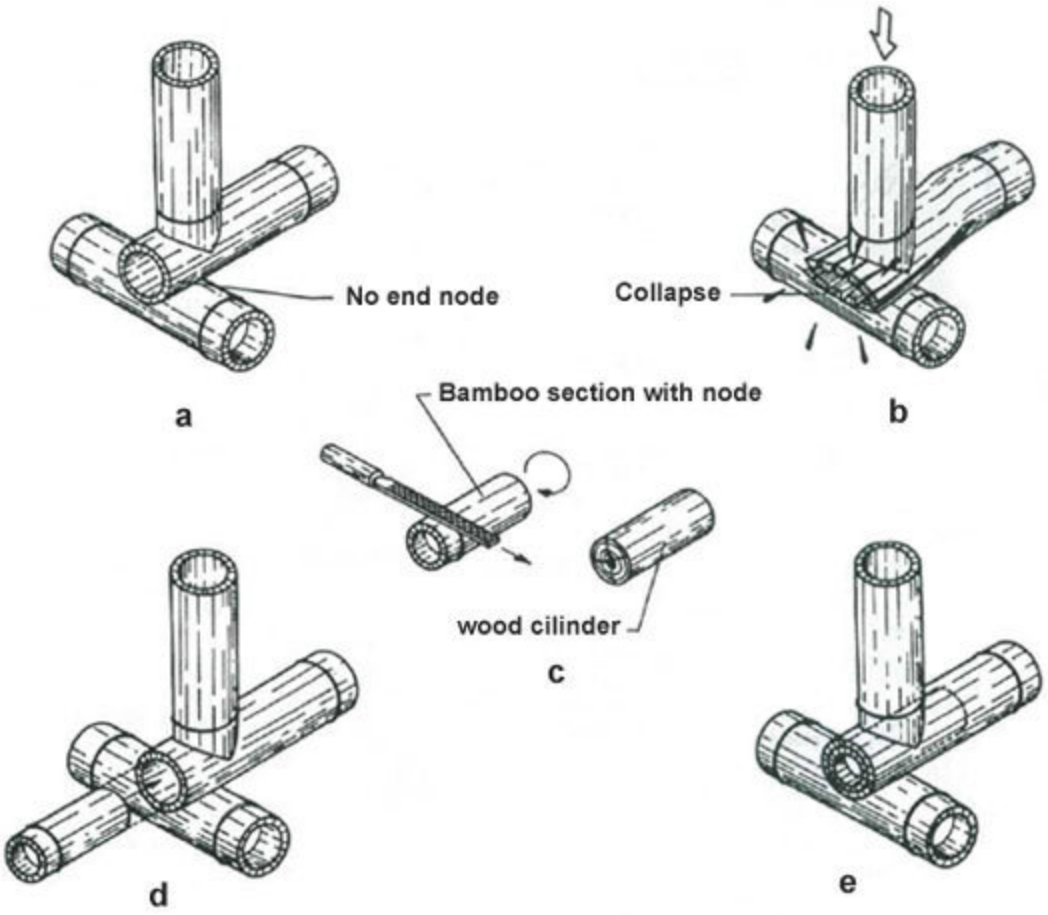


Figure 1 Bamboo Cuts

As you can see in the illustration below, making **basic cuts** in bamboo doesn't require expensive or heavy power tools, just a few traditional hand tools will work fine.

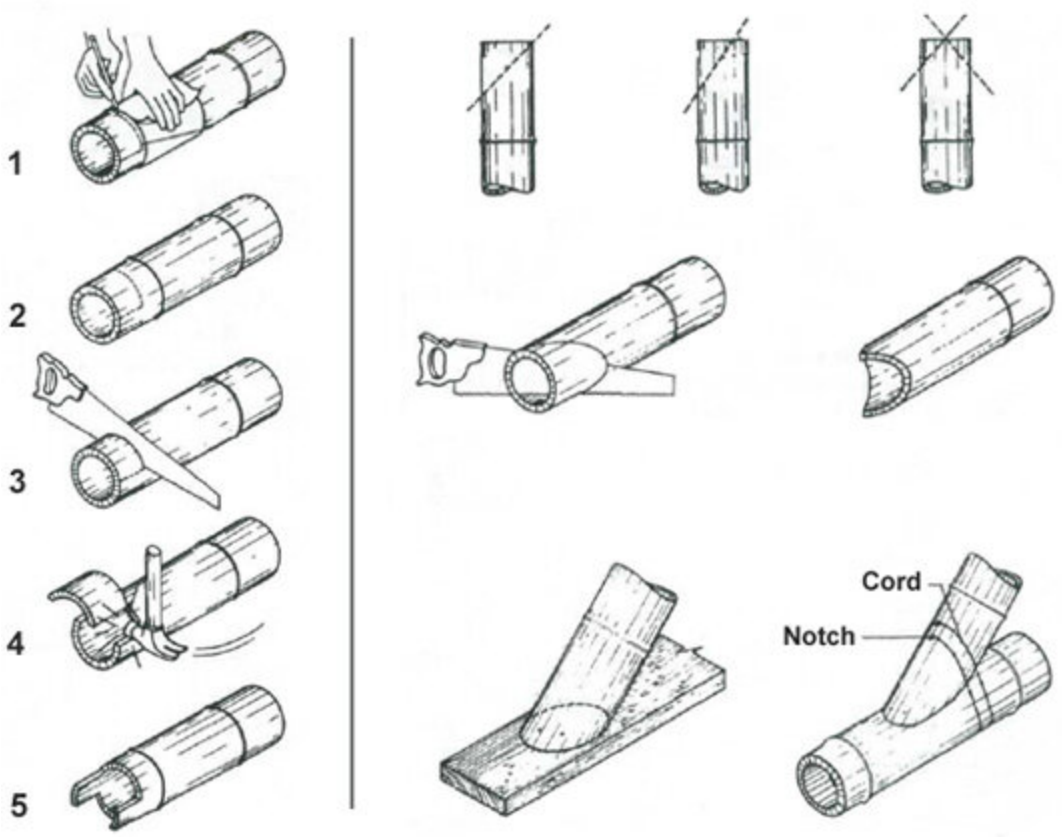


Figure 2 bamboo culm basic cuts

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer

1. What is joinery?
2. What is basic component in bamboo joint making?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date:** _____

- **You can ask your teacher for the copy of the correct answers after you try by yourself.**

Information Sheet 2 - Producing types of joints

2.1 Types of bamboo joints

There are many types of bamboo joints in bamboo furniture making as well as bamboo construction. The most common types of bamboo furniture joints are

- Fish mouth joint
- Bent mortise
- Joint with one or two ears
- Flap joint
- Bamboo joint with metal anchor
- Joining bamboo with dowels and lashing

2.2 Bamboo Joinery Techniques

Making good and aesthetically pleasing bamboo joints is rather complicated because bamboo is hollow, tapered, has nodes at varying distances, and it is not perfectly circular. It is important to keep all these constraints in mind when designing a bamboo joint.

2.3 General techniques for different kinds of joinery

1. Mark a straight reference line on the entire length of component using straightened bamboo slat or meter tape or wooden ruler. Mark the locations of joinery using measuring tape and pencils by keeping the straight line as reference. Marking aids are vital in making accurate joinery, assembly and thereby standardized product.
2. Depending on the design of the product and/or location of joinery, different methods or techniques are adopted
3. Cutting. Cutting a piece of bamboo with a crosscut saw requires technique. It is best done on a device that holds the bamboo firmly while it is being cut. While the right had pushes the saw back and forth, the left hand gradually turns the bamboo clockwise. Turning the bamboo counter-clockwise while it is being cut will damage the peel.

4. *Scraping*. Scraping is the process of removing the outermost skin of the bamboo while the use of a special tool called the bamboo scraper. Scraping however, may be done with a bolo.
5. *Marking*. Before splitting a piece of bamboo, it is necessary for the worker to divide the bamboo into convenient sizes. Marking prevents unnecessary waste.

2.4 Types of joints

- **The Fish Mouth**: - is named after the way one bamboo piece "bites" into its counterpart. This traditional joinery technique makes use of the bamboo's intrinsic properties by evenly distributing loads across the full section of the bamboo culm.
  - In bamboo furniture making the end of lining tube is often utilized to make a dowel on one hand, and a "fish mouth" on the other.
  - It is arranged to stand on one horizontal frame tube and sustain another horizontal frame tube above.
  - The internal joint partition and outer flannel of tube must be kept undamaged. Cut out a V size end; mend it into a U size end with a pointed knife like a fish mouth (Figure 7).
  - "Fish mouth" is cut out upwardly as a rule.

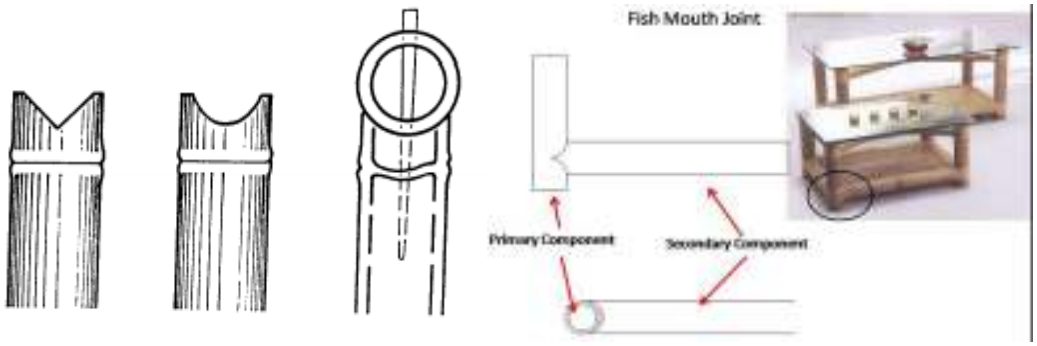


Figure 7 Fish mouth

- **Bent mortise**

Bent mortises and tub -tenon joint is very important in bamboo-furniture-making. They are made in following ways: During bent mortise making the following points should take into consideration:

- Grooves must be arranged on the space between joint knots, not on the knots
- There must be more than two grooves on one tube, arranged in the same direction.

a. Collective bent mortises

- Three or more than three bent mortises arranged on one and the same tube, which is to be processed into an enclosed form is called collective bent mortises.
- Collective bent mortises are essential part of bamboo-furniture-making techniques.
- The main frame of furniture is combined with lining parts and covering material by means of collective bent mortises.
- The process of making collective bent mortises includes elementary bent mortise making and the connection of both ends of tube. Collective bent mortises may be “equilateral triangle”, “square”, “pentagon”, “hexagon” and more.

b. Equilateral triangle bent mortises:

- The length of tube for making triangle bent mortises is equal to the sum of the length of three sides and three grooves.
- The length of grooves must be calculated in advance, it should be about 5/8 of the perimeter of tube-tenon.
- In practice the length can be reduced by 1 ~ 3 mm (Fig. 2)

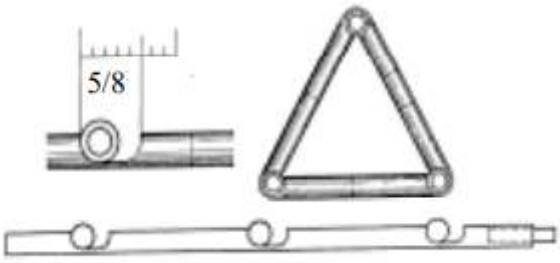


Fig. 2 Equilateral collective bent mortise

- The included angle of equilateral triple bent mortises is 60º, if the triangle form is not equilateral, the length of grooves and the included angles should be regulated accordingly.
- But most of the triangle bent mortises for bamboo furniture is equilateral.

c. Square bent mortises:

- The length of tube for making square bent mortises is calculated in the same way as that of equilateral triangle bent mortises.
- But the length of grooves is different. It is about 9/16 of the perimeter of tube-tenon(Fig. 3).

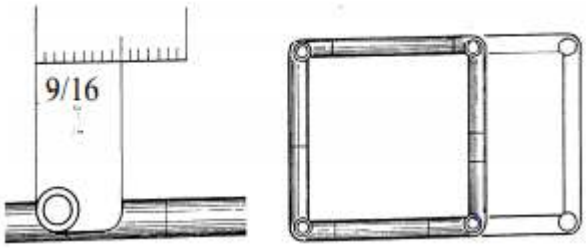


Fig. 3 Square collective bent mortise

(1) Rectangle bent mortises:

- The length of tube for making rectangle bent mortises is calculated in the same way as that of square bent mortises.

(2) Pentagon and hexagon bent mortises:

- The length of tube for making pentagon and hexagon bent mortises is calculated in the same way as stated above.
- But the length of groove is different. The length of groove for pentagon is _ of the perimeter of tube-tenon; the included angle is 108º.
- The length of groove for hexagon is 15/32 of the perimeter of tube tenon and the included angle is 120º.

d. Closed bent mortise:

- Closed bent mortise is to hold the tube-tenon closely. Cut a slit at 30 cm from the tube end, the depth of slit is half of the diameter of tube, cut out a groove, the length of groove is 7/8 of the perimeter of the tube-tenon (Fig. 4).

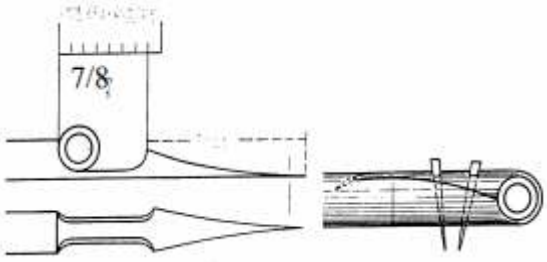


Fig. 4 Closed bent mortise

e. Connection of both the ends of tube

- The tube for making collective bent mortises is rather long, and the thickness of the two ends is different.
- They should be connected in a way similar to that for making closed bent mortise. The connection may be single (Fig. 5) or double (Fig. 6).
- But the following points should be taken into consideration:

Fig. 5 Single connection of mortise tube

Fig. 6 double connection of mortise tube

- The direction of retained tube wall must be perpendicular to the direction of groove, while the direction of retained tube wall for closed bent mortise is in the same direction of groove. The retained tube wall on both ends should be in opposite directions.
- The connective part of the tube forms a side of the geometric figure.
- The connection should be fixed with oblique bamboo nails.

f. Dowel and plane mortise

- Plane mortises are cut out on frame to hold dowels on lining material.
- They must be consolidated with bamboo nails.
- Bamboo material for making nails should be dried in advance to avoid the shrinkage of mails.
- Dowels can be made in different forms:

- **Central dowel**
  - ✓ Central dowel is made on the end of lining material.
  - ✓ Make two slits with a hand saw, the depth of slits should be 3/8 of diameter. Cut out dowels as shown in Fig. 7.
  - ✓ The mortise is made in the form of two holes on the frame.
  - ✓ The dowels are to be insert through the holes and reach the tube wall, the length of dowel equals to the diameter of tube minus the thickness of tube wall (Fig. 8).

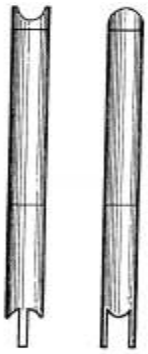


Fig. 7 Central dowel

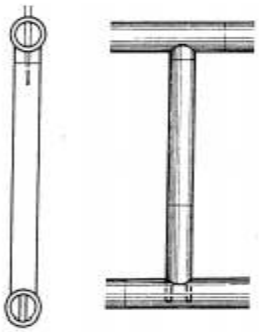


Fig. 8 Central dowel joints

- ✓ Another form of central dowel is penetrating dowel, it is a little longer and wider than central dowel.
- ✓ It penetrates the frame tube, going through the tube wall twice.

- **Single dowel**
  - ✓ Single dowel (Fig. 9) is made on the end of lining material.
  - ✓ Make a slit at about 2 cm from the end of lining material.
  - ✓ The depth of slit equals to the radius of frame tube.
  - ✓ Cut out a dowel, the dowel must be long enough to go through the hole on tube wall and reach the opposite wall.

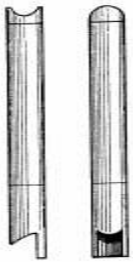


Fig. 9 Single dowel

- ✓ The mortise on frame tube must be made in the form of semicircle to fit the dowel.
- ✓ It is important that the straight side of semicircular mortise must be parallel with the direction of bamboo fiber, otherwise the connection will be failed (Fig. 10).
- ✓ The bent semicircular mortise and single dowel can be arranged horizontally or vertically.
- ✓ If it is made horizontally, the mortise hole must be cut upward; otherwise the strength of joint will be affected.

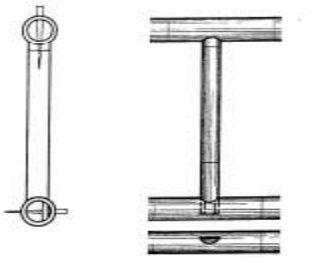


Fig. 10 Single dowel

- **Bamboo joint with metal anchor:** -This technique is used in various positions. It is done by cutting both assembled parts to fit each other and fix metal anchor and tight properly.

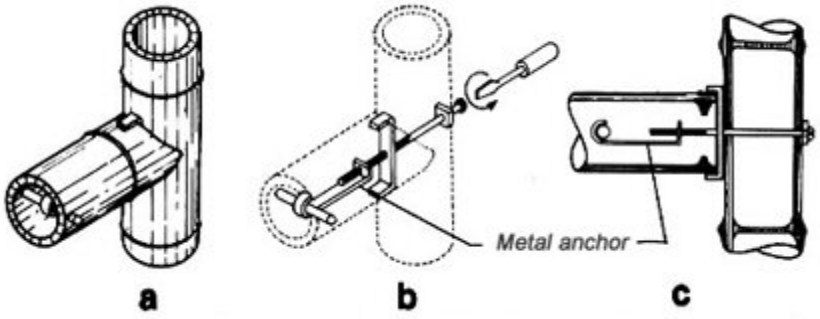


Figure 11 joint with metal anchor

2.5 Bending of bamboo

- Bamboo is of certain plasticity
- Using some pressure and/or heat, bamboo can be straighten or bended.

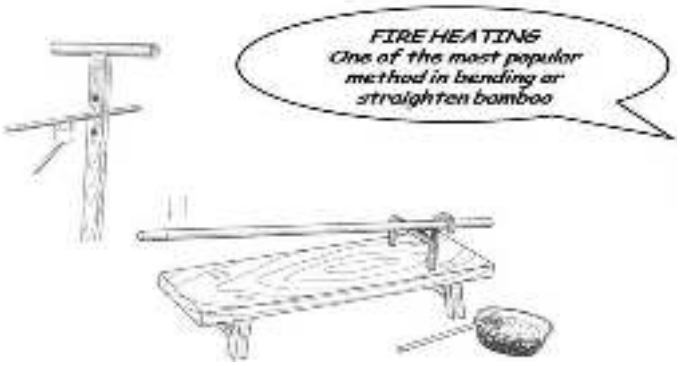
Figure 8 bended bamboo

Natural Growth

Figure 8 natural bended

Heating Method

- With enough water and raising the temperature… the plasticity can be improved
- In this way, bamboo can be straighten or curved using heat



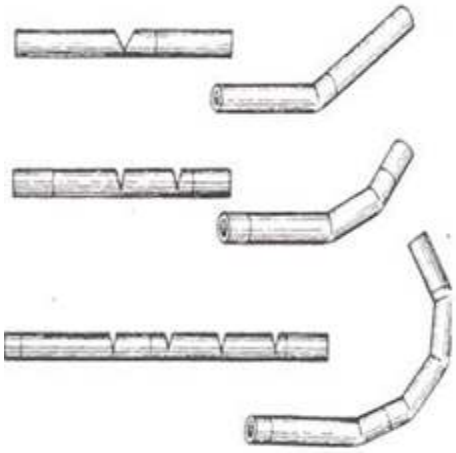
Bending by Groove Method

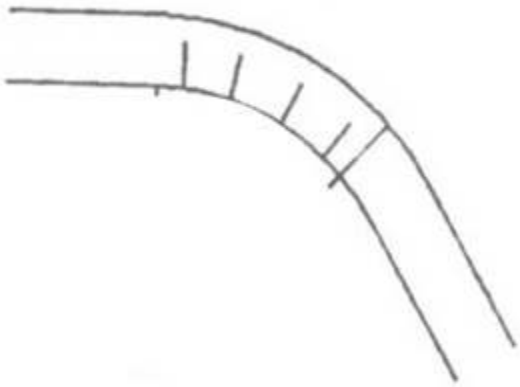
- Used in bending poles with large diameter.
- Size of groove is calculated in accordance with the predetermined curve
- It affects the strength of bamboo parts

Types of groove method bending

Broken line bending

Smooth curve bending

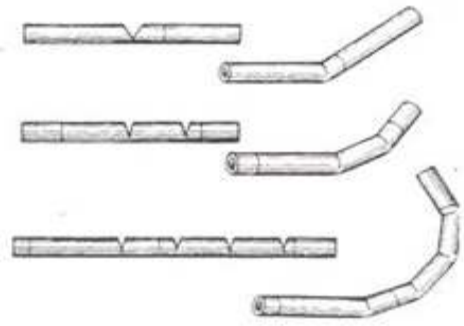


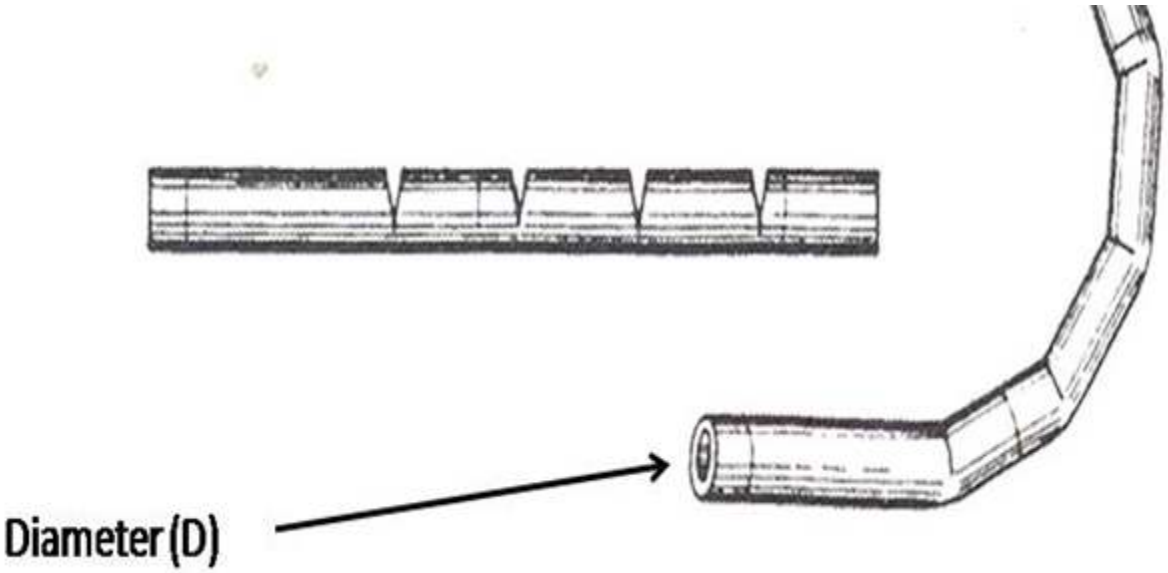


Broken line bending

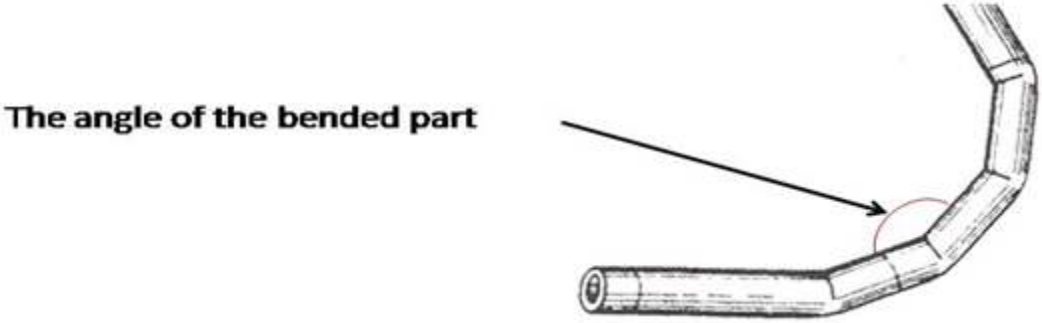
Variables in making broken line bending

Diameter of bent part (D)
Breaking Angle
Depth of groove (dG)
Length of Groove (lG)
Number of breaking angles (n)

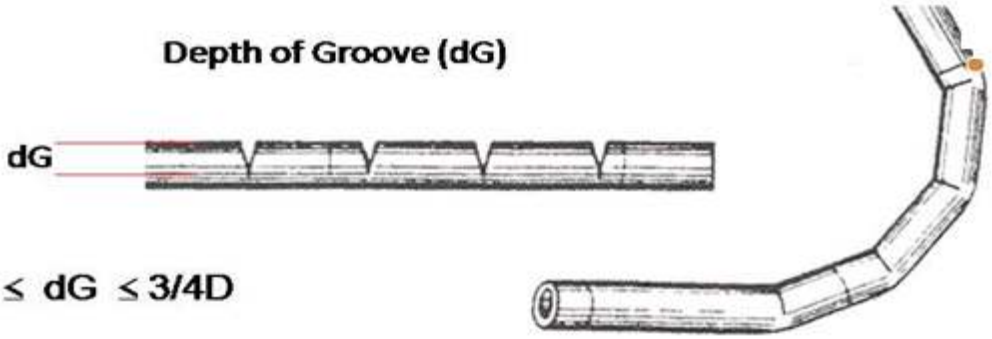




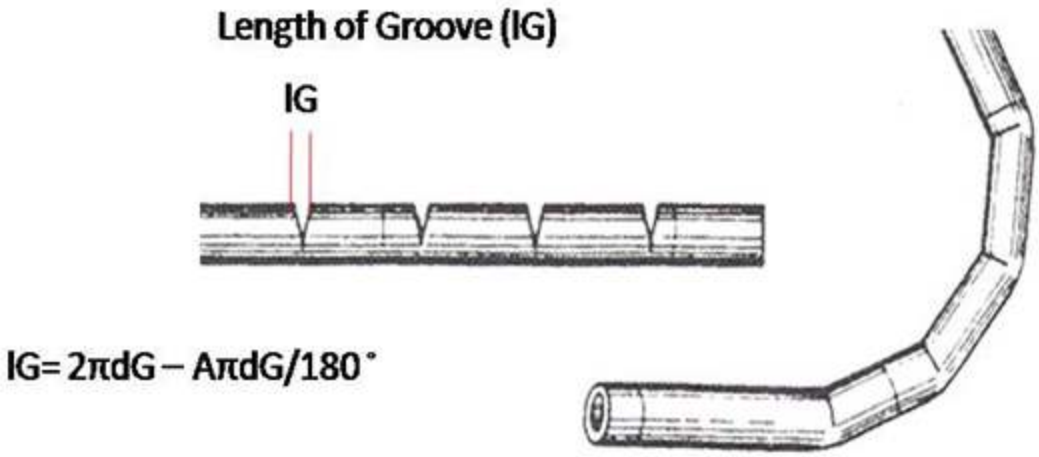
Bending Angle (A)



Depth of Groove (dG)

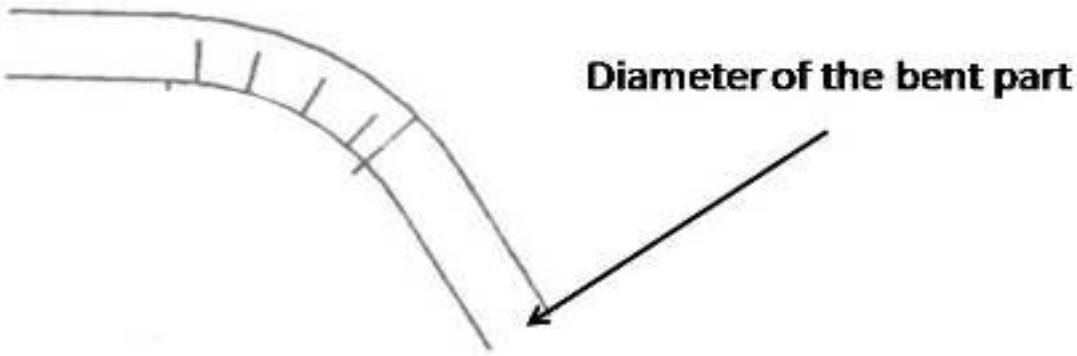


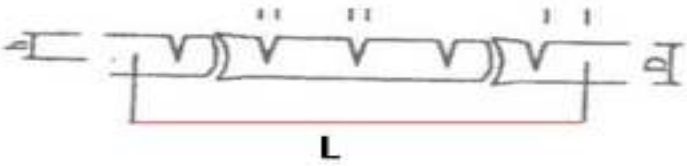
$D/2 \leq dG \leq 3/4D$

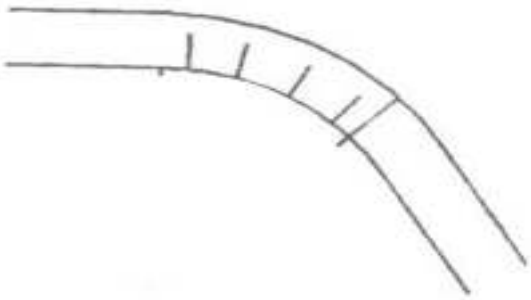


Bending Angle (A)

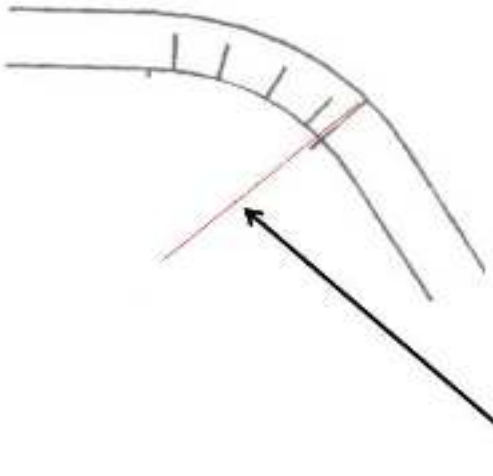
Number of Angles (n)	Bending Angle (A)	Length of Groove (lG)
3	60	5.23dG
4	90	4.71dG
5	108	4.39dG
6	120	4.17dG
8	135	3.92dG
12	150	3.66dG

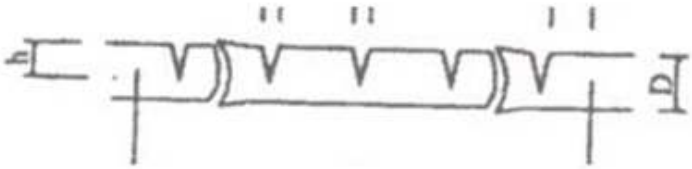




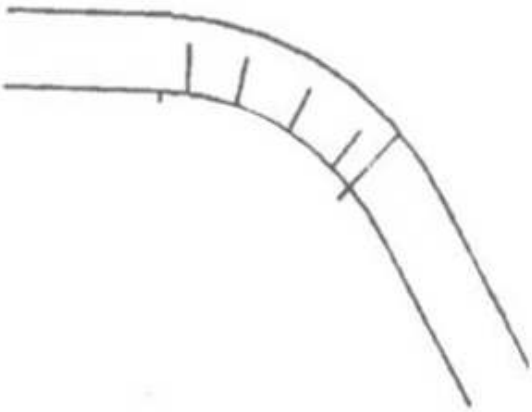


Length of the bent part (L)

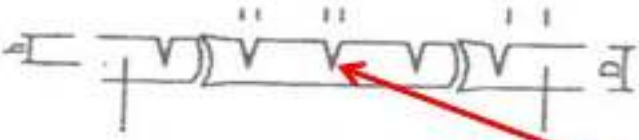




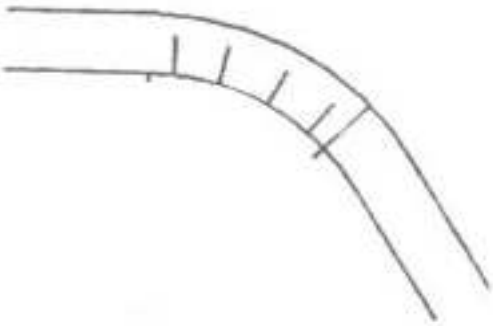
Number of Grooves (n)



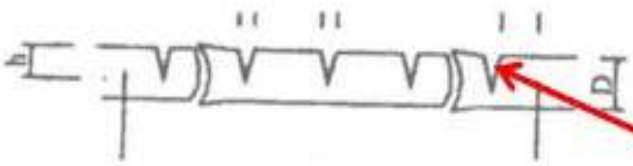
The more grooves the smoother is the curve



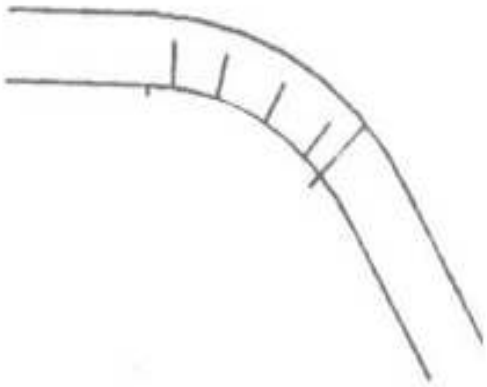
Depth of Groove (dG)



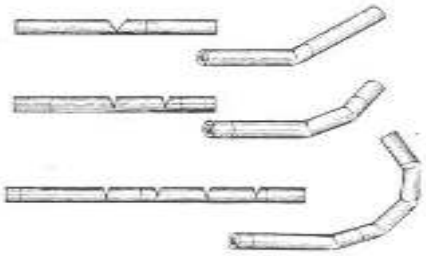
D/2 < dG < 3/4D



Length of Groove (IG)



$$IG = \frac{dG(L)}{nR}$$



Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List at list 4 types of bamboo joints.
2. …… joint evenly distribute loads across the full section of the bamboo culm.
3. ……. It is done by cutting both assembled parts to fit each other and fix metal anchor and tight properly.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date:** _____

- **You can ask your teacher for the copy of the correct answers after you try by yourself.**

Information Sheet -3 using fastening material

3.1 Fasteners

Fasteners are used to mechanically join two or more objects together, either permanently or non-permanently. There are many different types of fastener, each with their own purpose.

Fasteners can broadly be categorized as either Permanent or Non-Permanent. Permanent Fasteners, such as rivets and nails, are single-use fasteners that are designed to permanently join two materials or parts. Removing the fastener destroys it.

Non-Permanent fasteners, on the other hand are designed to allow for easy removal and re-use. Fasteners such as bolts and screws are commonly used in a number of industries and products as they allow for parts to be disassembled and re-assembled if required. Non-Permanent fasteners can be threaded (bolts, screws, etc.) or non-threaded (pins, retaining rings, etc.).

3.2 Threaded Fasteners

Threaded fasteners are among the most commonly used for assembling components due to the ease in which they can be installed and uninstalled as needed. There are three main types of threaded fastener; Bolts, Screws and Studs.

- **Bolts** have a head on one end (this is usually a hex head) and are threaded on the other. They are generally used in conjunction with a nut (and sometimes a washer) to hold them in place.
- **Screws** are similar to bolts in that they have a head on one end and a thread on the other. They key difference is that screws are usually used to screw into an internally threaded hole. There are many different types of screws, such as Cap Screws, Machine Screws, and Woodscrews.
- **Studs** are threaded on both ends, and therefore have no head. They are used to join two components with internally threaded holes together.

  Fastener threads are standardized to two major standards: ISO (Metric) and ANSI (Unified). Threads can also be right-handed or left-handed, depending on the application. However, the majority of common fasteners are right-hand threaded.

- **Glue**

  Glue is any adhesive that is applied in liquid form and dries hard to hold materials together. Technically, true glues are made from organic compounds like animal collagen. However, many products marketed as glue are in fact synthetic adhesives made with polyvinyl acetate (PVA) emulsions. These synthetic adhesives are also sometimes referred to as gums or cements.

  Other types of adhesives, including epoxy, caulk, and sealant, have many similarities with glue. However, they are created with specific jobs in mind and have specific additives that provide these task-specific qualities; glue is a more multi-purpose adhesive and thus has a more basic recipe.

3.3 Applying Glue on Joints

If your glue joints have a tendency to fall apart, don't blame the glue. You must be doing something wrong, because modern woodworking glue will produce joints that are actually stronger than the wood itself. All you have to do is use the glue properly.

1. Make sure the joint fits together well. No glue will give much strength if the parts being glued are rough, warped or poorly cut. These keep the parts from fitting snugly.

2. Make sure the wood is clean. Glues rely on penetration to achieve full strength, but wax, dirt, grease, even natural resins in the wood can interfere with penetration. Wipe parts to be joined with a rag dampened with a strong solvent, such as lacquer thinner.

3. Avoid end-grain joints when possible. End grain is naturally weak, and it soaks up glue like a sponge, drawing it deep into the wood and out of the joint. The result is a dry, weak bond. If you can't avoid and end-grain joint, reinforce the joint with cleats, nails, screws or dowels. Or use special joints that interlock to add strength.
4. Before gluing - thin the glue (use water for white glue or yellow carpenter's glue) about 50 percent.

5. Apply a coat of this thinned glue to the end grain and let it soak in for half an hour. Then apply full-strength glue and assemble the joint.

Figure 12 joint with fastener

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is fastener?
2. List types fastening materials?
3. What is glue?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date:** _____

- **You can ask your teacher for the copy of the correct answers after you try by yourself.**

Operation sheet 1– techniques of producing joints

1.1 techniques of producing fish mouth joint

1.1.1 tools and equipment

- Protective wear
- Four pieces of treated dry bamboo, three have a larger diameter than the last one. For instance, with a culm piece of 7 cm diameter, try to have a smaller piece of around 4 cm.
- An electric drill, with bits of 3 to 4 mm diameter
- A mutik (traditional bamboo carving knife), chosen according to your dominant hand
- A curved chisel
- A hammer (c)
- A few wooden dowels (at least 10)
- A pencil
- A ruler/tape rule
- A hand saw

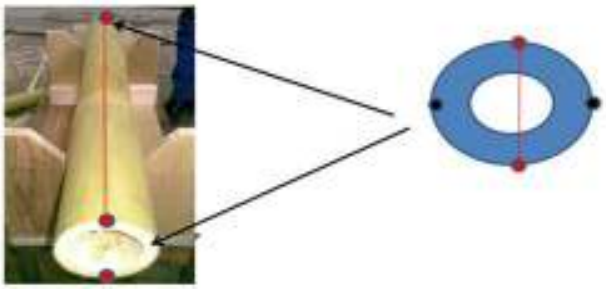
1.1.2 Procedures (steps)

I. wear proper PPE

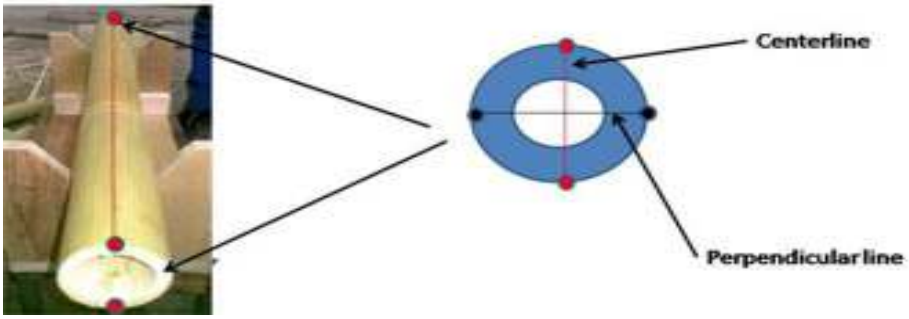
II. Prepare the fish mouth:

III. Finding and marking the centerline

a. Use the centerline as reference point, divide the ends of the bamboo into four (4) parts



b. Use a straight edge or tri-square draw a line perpendicular to the centerline

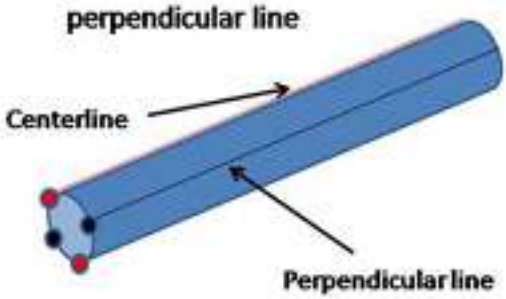


c. Using a straight edge, draw a line connecting the perpendicular lines at both ends. Draw on both sides.

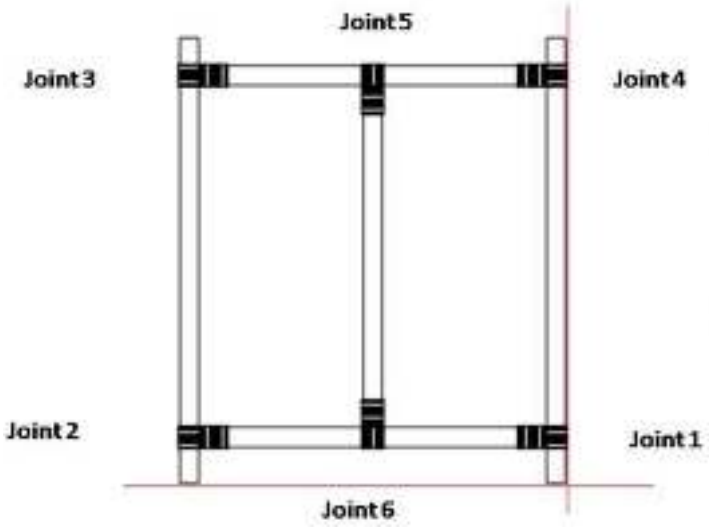
d. Examine the drawing or sample product. Check where the product should look straight.

Centerline should face where it should look straight.

In this case, joints should be positioned on the perpendicular line



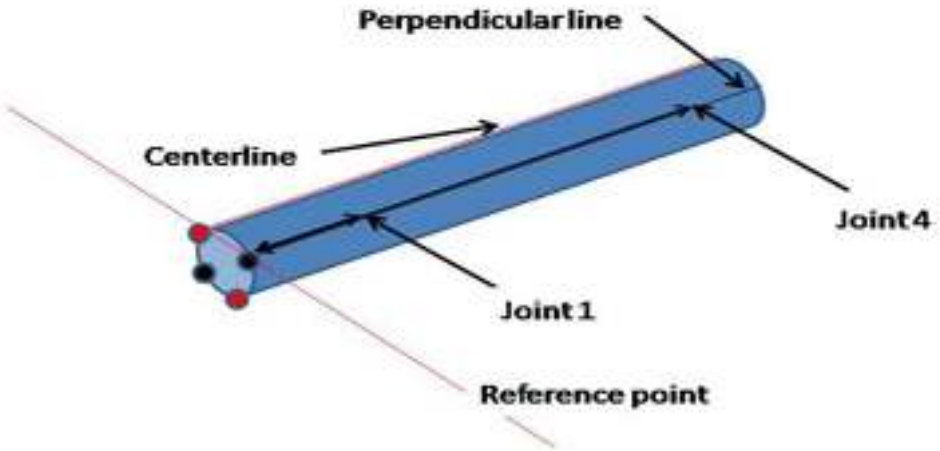
e. Identify the reference point (Vertical. Horizontal, Diagonal)



For Joints 1,2,3,&4 take the Horizontal as reference and for Joints 5 &6, the vertical

Start measuring from the reference point

f. Identify the reference point (Vertical. Horizontal, Diagonal)



IV. Cut close to a node (use the diameter as reference).Then, divide into four equal parts. Between the node and the end of the column, draw a line around the surface. The distance from the end of the column and the line should be the same as the radius of the beam.

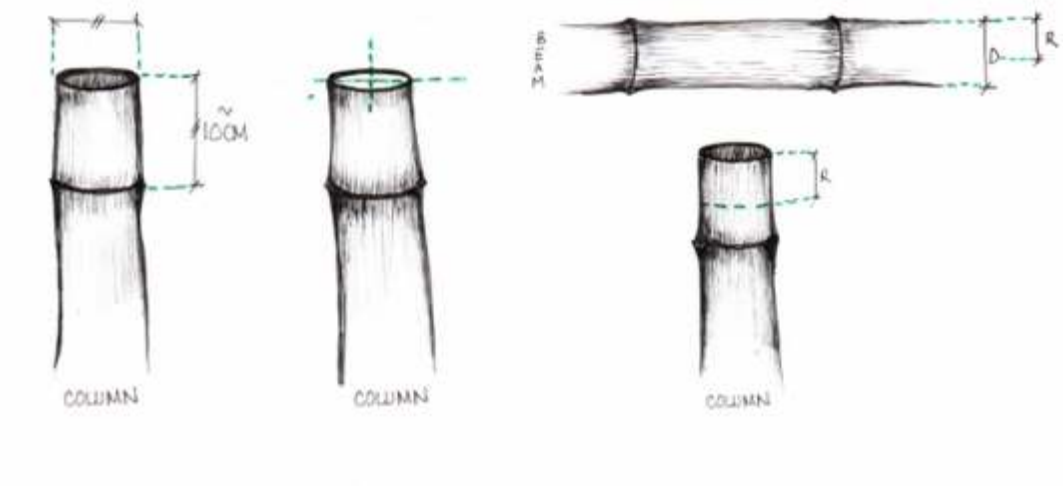


Figure 10 measuring fish mouth

V. Draw an approximate shape for your fish mouth. Hold the column and saw along the diagonals.

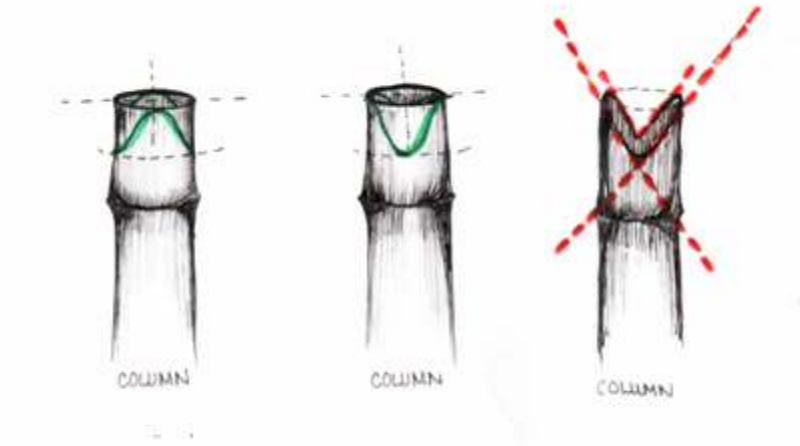


Figure 11 marking fish mouth

VI. Then, carve out the mouth's shape in upwards motions (working in the same direction as the bamboo fibers)

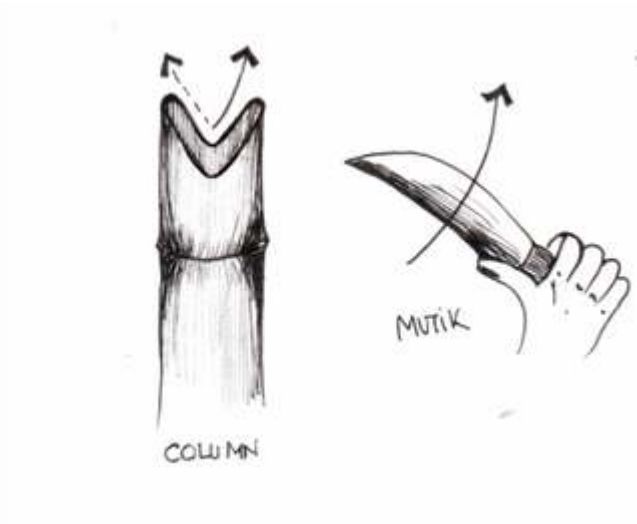


Figure 12 marking fish mouth

VII. Make the hole joint:-

- ✓ Take the third, smaller piece of bamboo. It will act as the tie between the column and beam.

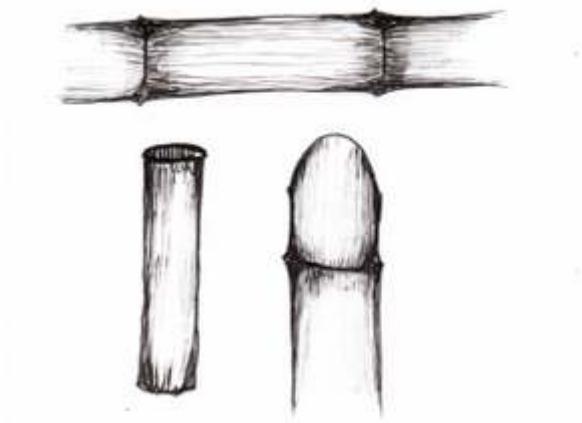


Figure 13 marking fish mouth

VIII. Draw out its diameter on the beam, where the fish mouth will sit. Taking the chisel carve out the "hole".
Slot the piece in, it should fit in tight and all the way through to the opposite culm wall.

IX. Drill and dowel.

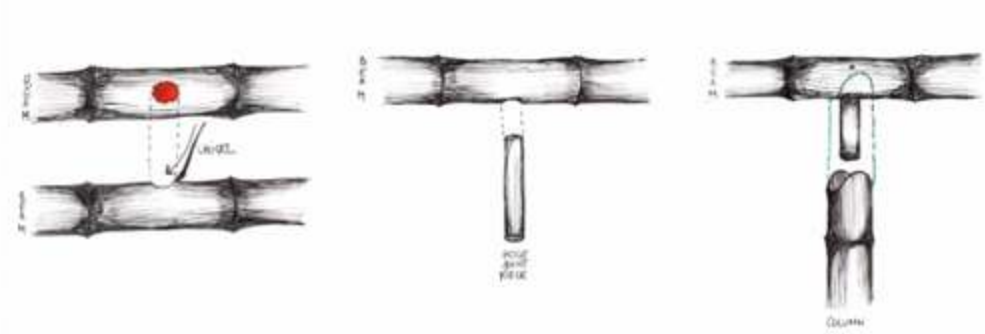


Figure 14 drilling hole

X. Slip the column over the smaller bamboo piece to secure the fish mouth to the beam. Drill and dowel through the column and the small bamboo at opposite angles.

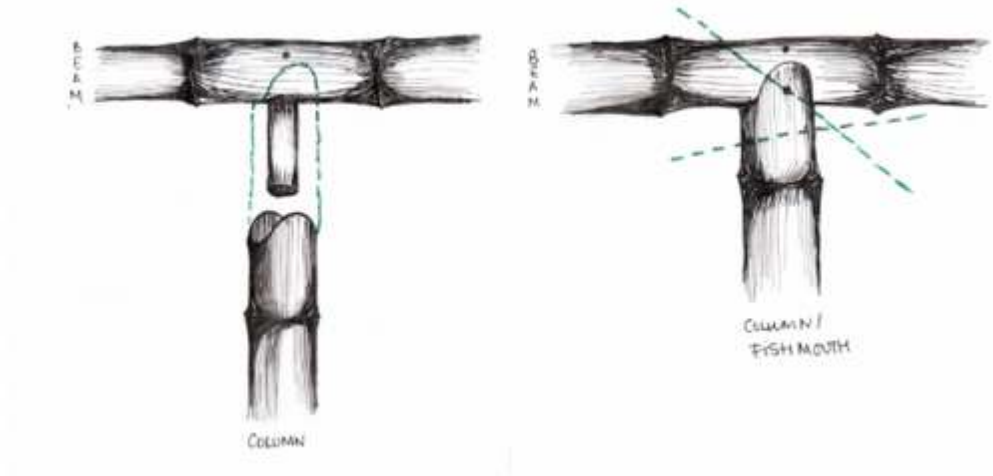


Figure 15 fitting smaller tube

In this form, the joint is commonly used for furniture design and smaller structures.

XI. Make the cross-brace:

✓ To achieve this, measure the same distance from the fish mouth to where the cross-brace will sit on both the column and beam.

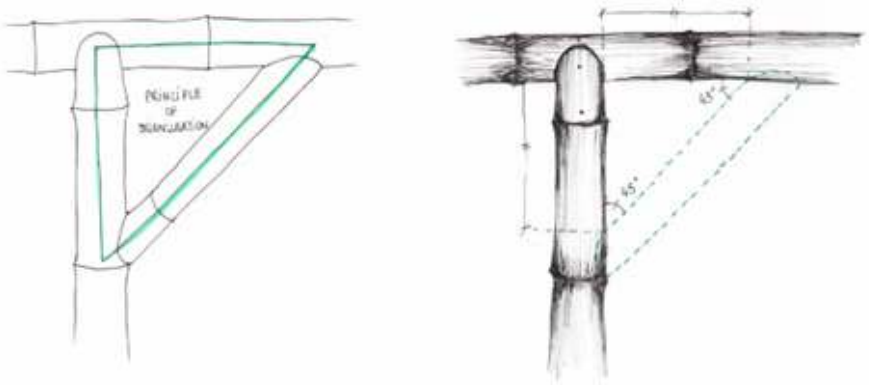


Figure 16 making cross-brace

XII. Measure the values of a and b (see drawing). They determine the depth of your cut. Saw accordingly.

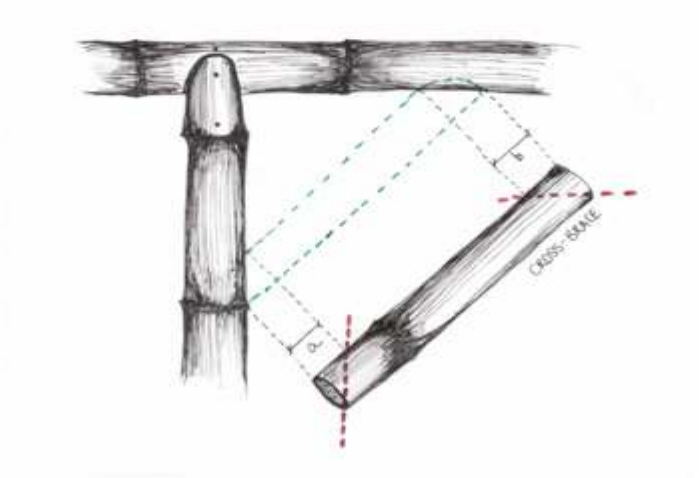


Figure 17 measuring values

XIII. Using the mutik, carve out the right shape for the brace to sit on the beam or column. And secure it by drilling dowels on it.

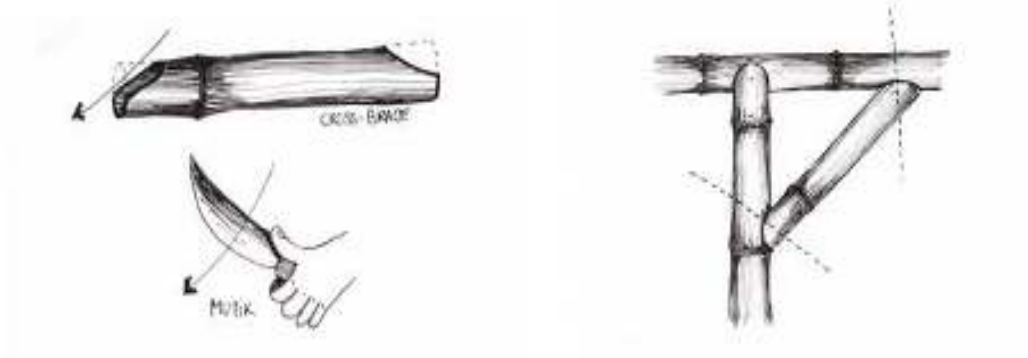


Figure 18 cut and assemble

The art of joining bamboo together relies principally on a strong understanding of the material as well as a careful hand (or two). The fish mouth joint testifies to beautiful craftsmanship and strength. It is something we are privileged to be able to share here and during our courses.

Operation Sheet 2	Bent mortise and tube-tenon

Bent mortise and tube-tenon

- **Tools and Equipment**

  - ✓ Diameter gauge
  - ✓ Tap meter
  - ✓ Pencil
  - ✓ Tri- square
  - ✓ Workbench with
  - ✓ Electric solder or LPG torch
  - ✓ Hand saw
  - ✓ Gouge chisel

A. *Procedures and techniques to make* bent mortise

1. Make two paralleled slits on surface of bamboo tube, the space between slits is equal to the length of groove.
   - ✓ This is determined according to the thickness of tube-tenon.
   - ✓ The depth of slits may be larger than the radius of the tube, but not exceed 3/5 of its diameter.
   - ✓ Then gouge out a groove on the tube between slits.
2. Make groove to fit the predetermined tube-tenon.
3. Remove the yellow part on the groove.
   - ✓ Bend the grooved tube to form a bent mortise.
   - ✓ The thickness of bent part should be 0.2 ~ 0.5 cm (Fig 1). In order not to break the tube at bending, it is recommended to heat the tube by means of fire or boiling water.

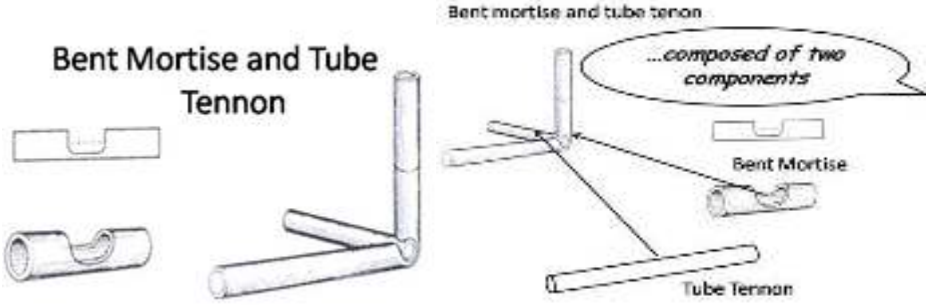


Figure 19 Groove for making bent mortise

Operation Sheet 1	Straightening bamboo by Fire Method

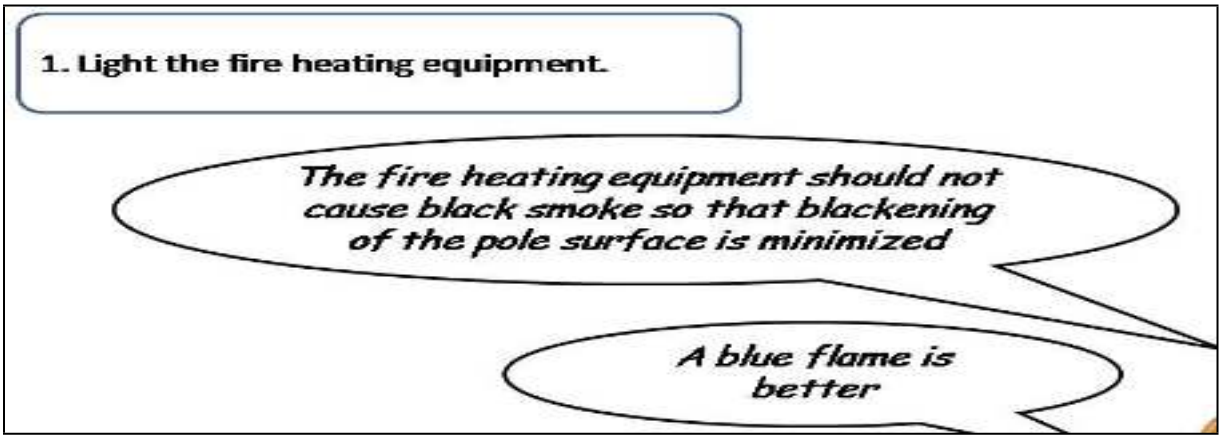
Operation Title: Straighteniong bamboo by fire heating

Purpose:

Tools, Equipment and Materials

- Fire Heating Equipment
- Lighter
- Bending Block

Procedures



2. Apply heat on the portion of bamboo to be straighten

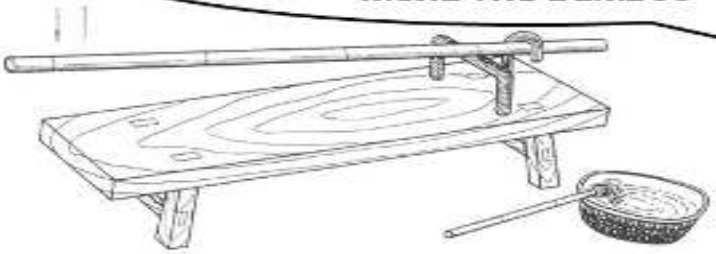
Move back and forth to make the heating evenly on.

Avoid the occurrence of charring

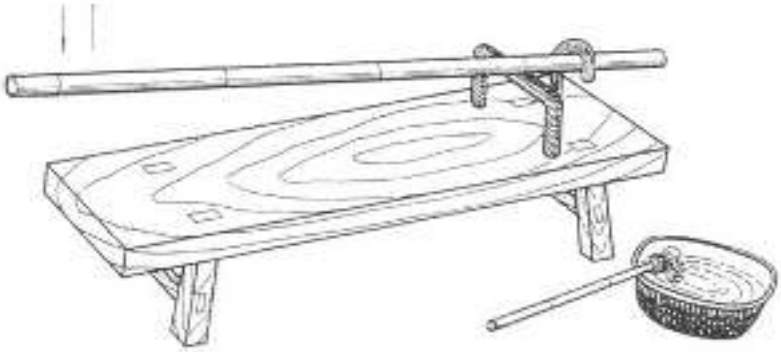
Charring can be avoided by occasionally wiping the surface with wet cloth

3. Mend the bamboo in the bending block

When bright oil appear on the surface of the heated portion, mend the bamboo



4. Repeat steps 2 and 3, until all the curve portions are straighten.



Operation Sheet 4	Bending Bamboo Fire Heating

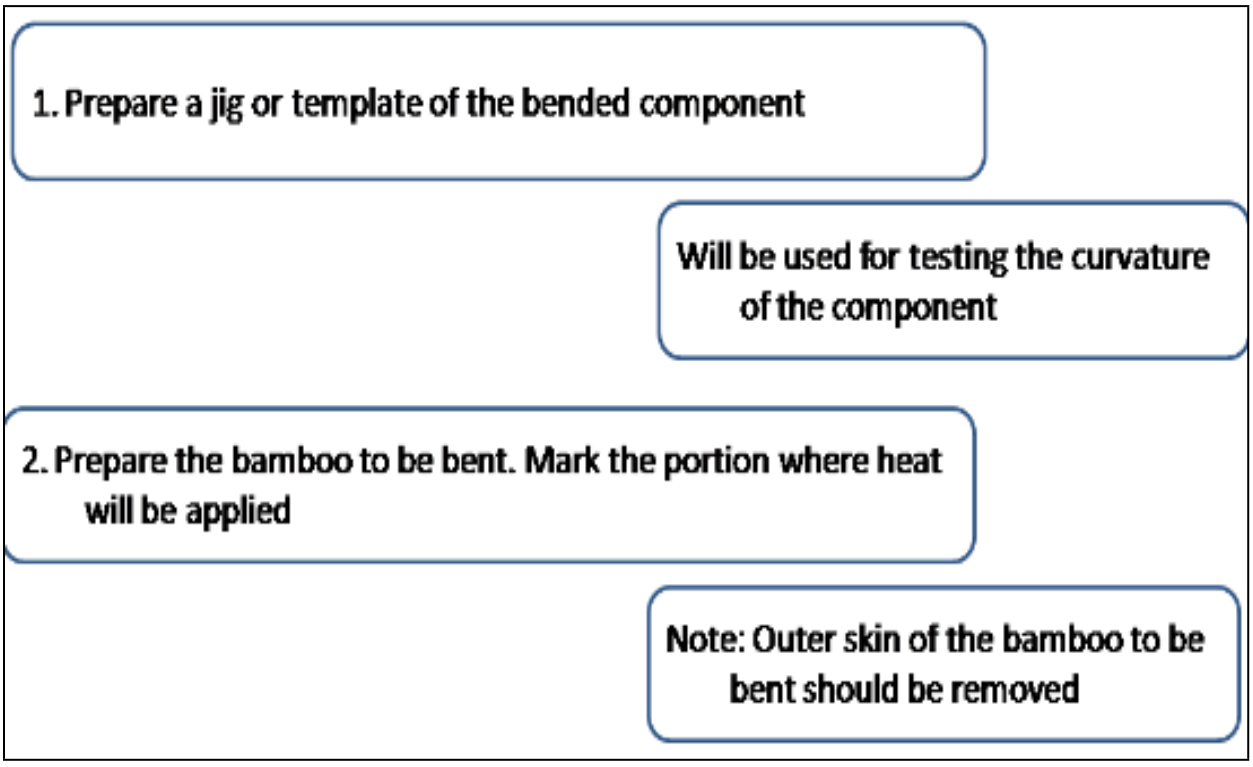
Operation Title: Bending bamboo by fire heating

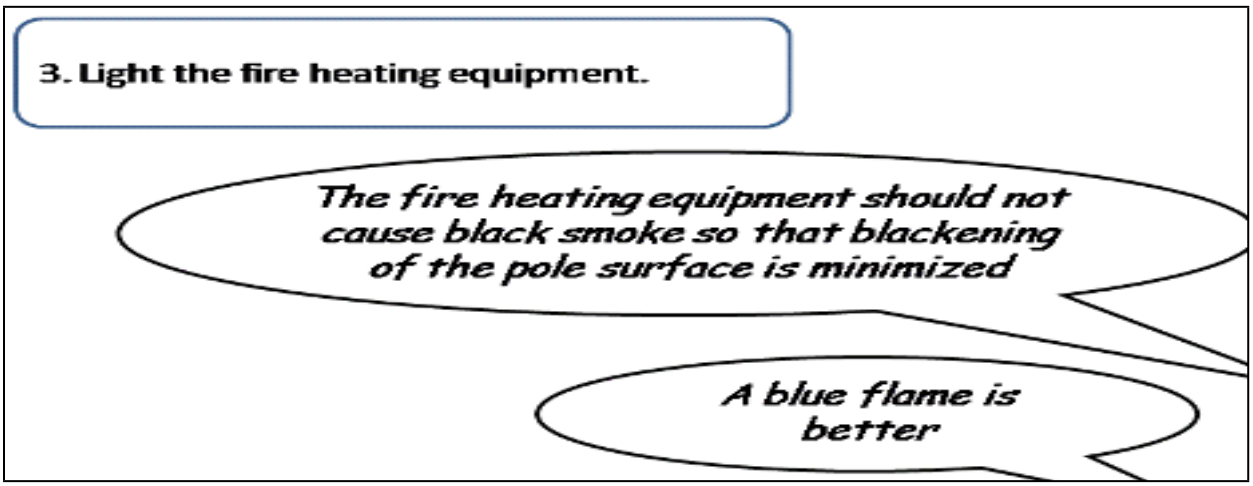
Purpose:

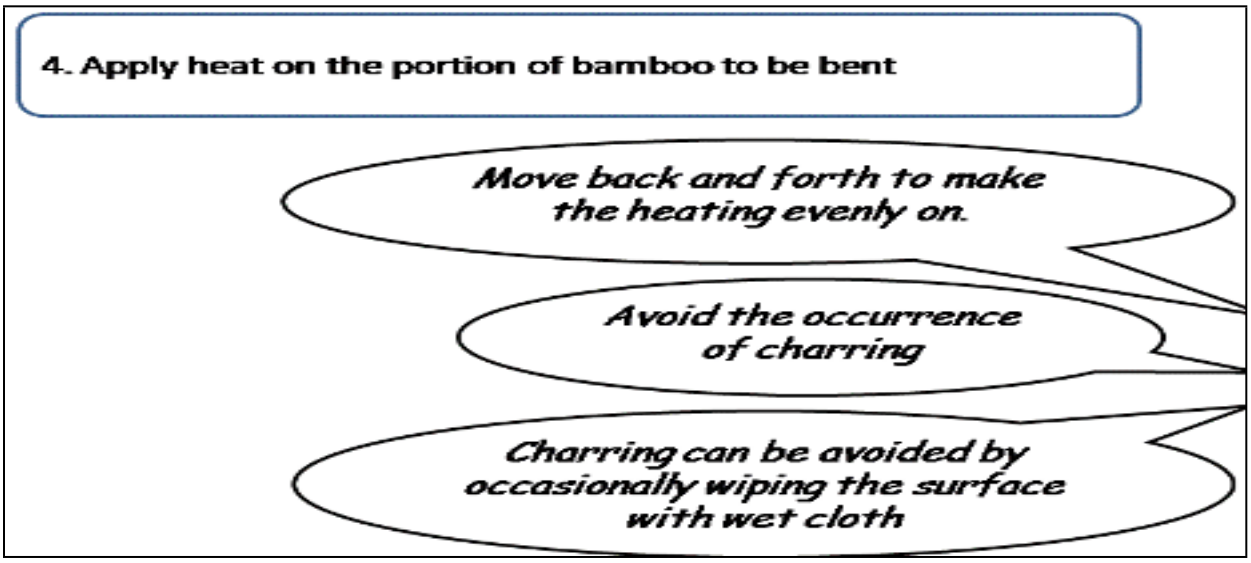
Tools, Equipment and Materials

- Fire Heating Equipment
- Lighter
- Bending Block
- Cross Cut Saw
- MAtchete
- V-Block

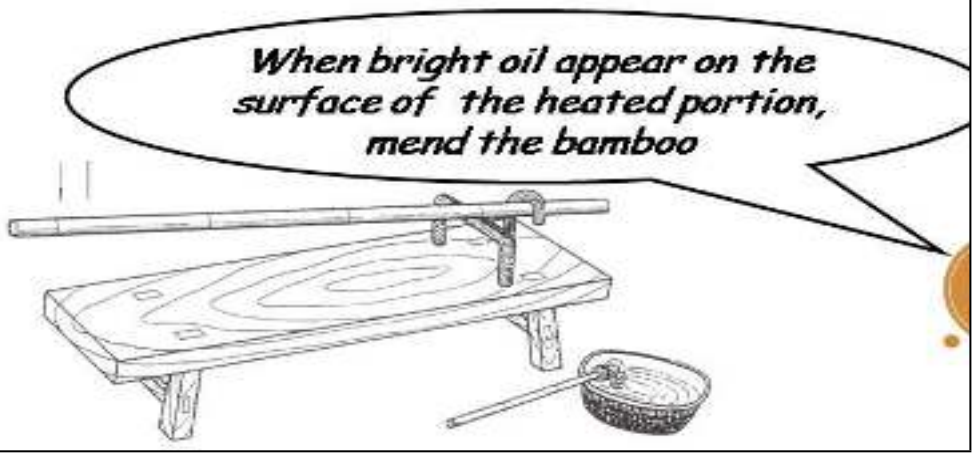
Procedures



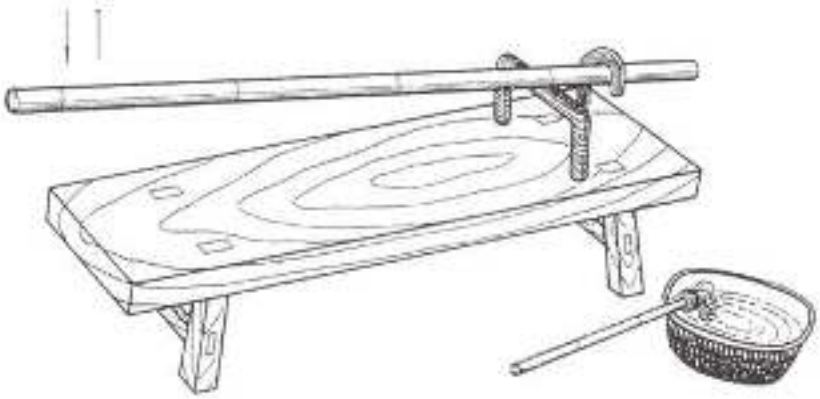

3. Light the fire heating equipment.
The fire heating equipment should not cause black smoke so that blackening of the pole surface is minimized
A blue flame is better


4. Apply heat on the portion of bamboo to be bent
Move back and forth to make the heating evenly on.
Avoid the occurrence of charring
Charring can be avoided by occasionally wiping the surface with wet cloth

5. Mend the bamboo in the bending block



6. Repeat steps 4 and 5, until all the curve portions are straighten. Check the curvature using the prepared template or jig



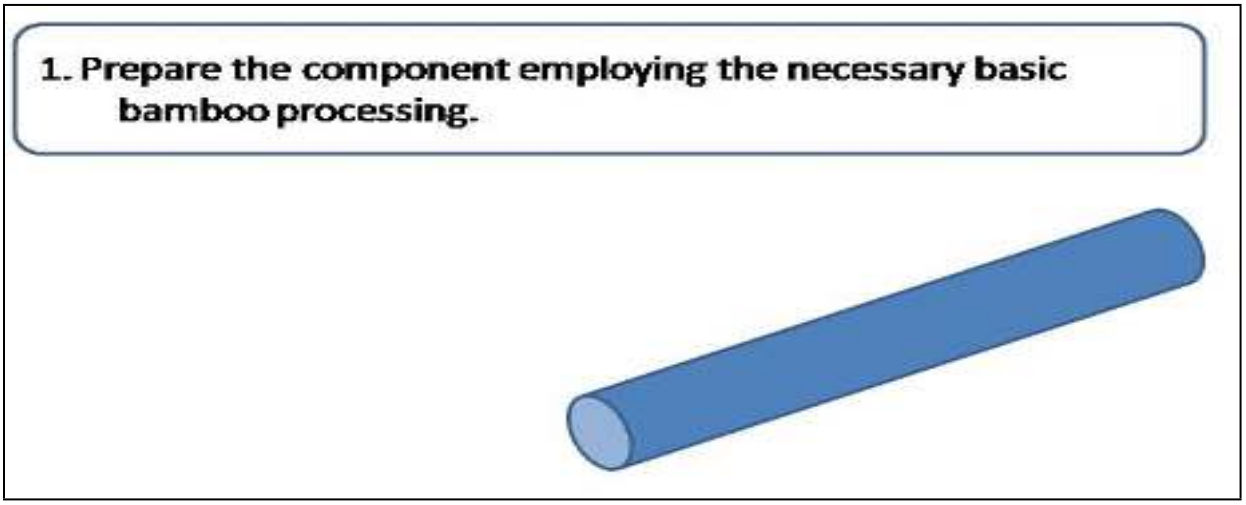
Operation Sheet 3	Broken Line Bending

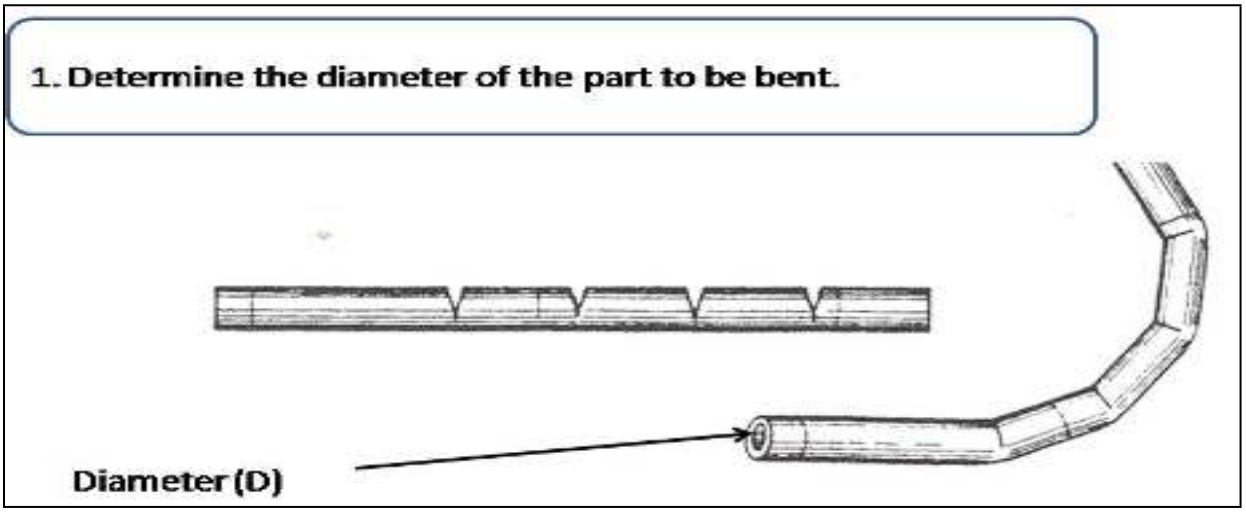
Operation Title: Broken Line Bending

Tools, Equipment and Materials

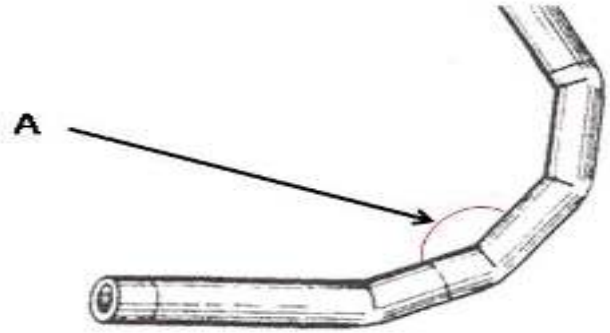
- V Block
- Matchete
- Cross Cut Saw
- Tape Rule

Procedures:

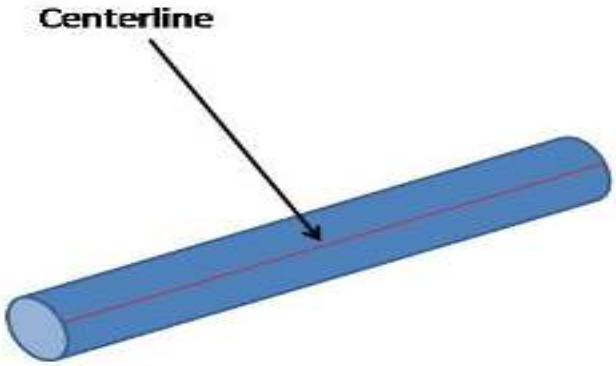




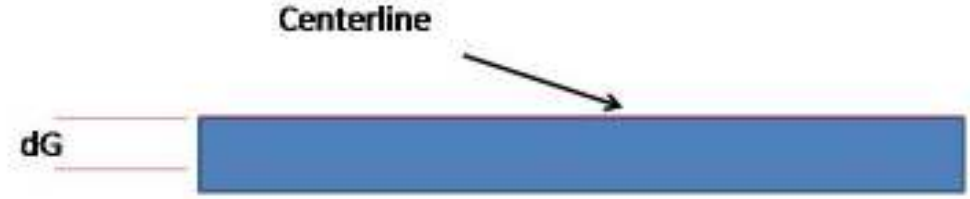
2. Determine the bending angle (refer to the drawing)



3. Find and mark the centerline of the component

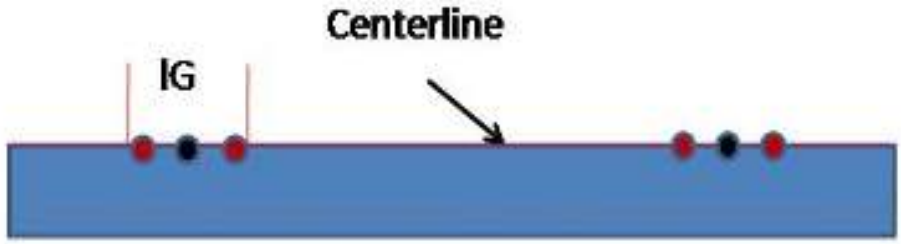


4. Determine depth of groove(dG) and mark it on the bamboo. (Use the centerline as reference)

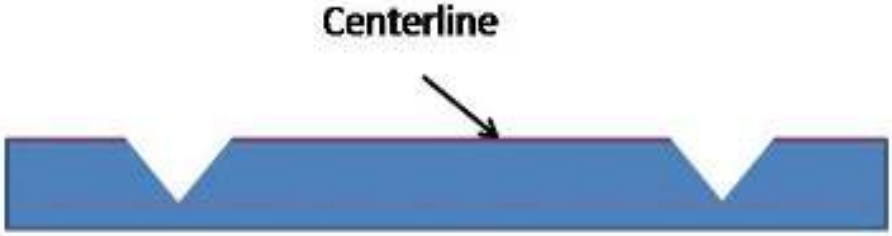


D/2 ≤ dG ≤ 3/4D

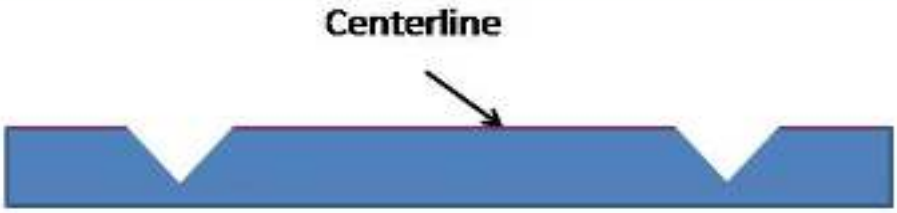
5. Mark the position of the grooves



5. Cut the grooves using hack saw or other similar cutting tools



6. Mend the groove by removing some of the inner flesh.



LAP Test	Produce Bended Components

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **5** hour. The project is expected from each student to do it.

Task 1 Make Fish mouse joint

Task 2 Bend given bamboo culm by using broken line method

LG #18	LO #4- Clean up

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Cleaning and storing tools and equipment
- Tagging and reporting defective equipment
- Cleaning work area
- Collecting and storing cut-offs, unused and scrap materials

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Clean and store tools and equipment in accordance with workplace procedures
- Tag and report faulty and/or defective equipment is according to workplace practices
- Clean Work area, collect and store Cut-offs, unused materials and scrapped materials for reuse or disposal following workplace procedures

Learning Instructions:

- Read the specific objectives of this Learning Guide.
- Follow the instructions described below.
- Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
- Accomplish the "Self-checks" which are placed following all information sheets.
- Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
- If you earned a satisfactory evaluation proceed to "Operation sheets
- Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
- If your performance is satisfactory proceed to the next learning guide,

Information Sheet 1- Cleaning and storing tools and equipment

1. Cleaning and storing tools and equipment

1.1 Clean, Inspect and Care for Tools

Make it a habit to clean tools after each use before you return them to storage. Wipe them down with a rag or old towel and be sure they are free of dust, grease and debris before you put them into their proper places. This is also an opportunity to look for any damage or defects

Figure 1 tool storage

- **10 ways to make your equipment last longer**

✓ Read the User Guide. ...
✓ Use the Correct Equipment For The Job. ...
✓ Know Your Machinery. ...
✓ Inspect Regularly. ...
✓ Carry Out Regular Maintenance, Using a Schedule. ...
✓ Replace Parts When Needed. ...
✓ Clean After Use. ...
✓ Repair and Refurbish, Rather Than Replace.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is cleaning?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date:** _____

- **You can ask your teacher for the copy of the correct answers after you try by yourself.**

Information Sheet - 2 Tagging and reporting defective equipment

2.1 Tagging and reporting defective equipment

If you find that tool is defective and that you are not qualified or assigned to repair follow the procedures:-

1. Obtain defective or out of service tag card designated for defective tools
2. Fill out defective or out of service tag. Wire the tag to the equipment around the shut off button
3. The trainer will log out of service tag in to the maintenance records and the tool will be repaired or replaced.
4. If repaired the trainer will have repair made and the tool returned back to production and remove out of service tag.

By taking proper care of tools, you'll ensure that they'll remain in good working order and will be ready for use when you need them.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is housekeeping?
2. What is scrap?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date:** _____

- **You can ask your teacher for the copy of the correct answers after you try by yourself.**

Information Sheet - 3 cleaning work area

1.1 House kipping

Effective housekeeping can help control or eliminate workplace hazards. ... Housekeeping is not just cleanliness. It includes keeping **work areas** neat and orderly, maintaining halls and floors free of slip and trip hazards, and removing of waste materials (e.g., dust, bamboo chip, bamboo scrap…..etc.) and other fire hazards from work areas. Cleaning work area must be carried out on a regular basis

- **Ways to Keep Your Workspace Clean**

1) Use proper storage for everything. ...

2) Get rid of what you don't use. ...

3) Make clean all walk way and flour. ...

4) Shop around for cleaning supplies. ...

5) Organize your tools equipment and materials. ...

6) Use proper tool during every operation...

7) Take turns cleaning.

Figure 3 cleaning floor

Self-Check – 2	Written test

Name…… ID……

Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is fastener?
2. List types fastening materials?
3. What is glue?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date:** _____

- **You can ask your teacher for the copy of the correct answers after you try by yourself.**

Information Sheet - 4 collecting and storing cut-offs, unused and scrap materials

4.1 Waste collecting and storing

Waste collecting bins are pile-up stations of different sizes, shapes, and materials that help to reduce the spread of litter. The different types of waste collecting containers are localized containers, centralized bins stations, waste transfer carts or transfer balers, and waste yard dumpsters. Localized containers also called desk-side bins and are individual refuse bins whose purpose is to increase efficiency in the correct handling of waste. For example, they are a close point to throw minor personal trash such as papers. They encourage people to keep their garbage organized, thus promoting the recycling of wood waste

Figure 4 bamboo scraps

The second category is centralized bin stations or high traffic containers. These are placed in strategic points and are the recipients of waste assembled from the localized containers. Most furniture workshops have these bins in their hallways and corridors for storing wood waste from personal employees' work stations.

The third type is the waste transfer carts, also known as utility carts. Their primary purpose is to receive refuse from centralized stations and move or cut them if it is a transfer baler. They are big containers that carry more waste and are economical compared to buying numerous high traffic containers. The refuse yard dumpster is the last designated point that stores large amounts of waste. They are mostly huge and receive tones of wood waste from transfer balers.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is fastener?
2. List types fastening materials?
3. What is glue?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date:** _____

- **You can ask your teacher for the copy of the correct answers after you try by yourself.**

Operation Sheet 4	Perform cleaning

Operation title clean work area

1. **Tools and equipment**
   - Broom
   - Brush
   - Towel
   - PPE

1.1 Steps to clean work area

1) Use proper PPE

2) Use proper storage for everything. ...

3) Make clean all walk way and flour. ...

4) Shop around for cleaning supplies. ...

5) Organize your tools equipment and materials. ...

6) Use proper tool during every operation...

7) Take turns cleaning.

LAP TEST	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 3 hours. The project is expected from each student to do it.

2. Clean up

3.1 Clean tools and equipment

3.2 Clean work area

Reference Materials

Books

1. Bamboo Architecture & Design (Architecture & Materials) Chris van Uffelen
2. The Book of Bamboo *by David Farrelly*
3. NEW BOOK - Discovering Bamboo 7 X 11 in., 82 pages, glossy paper, paperback, 186 color photos, 2006
4. The Craft & Art of Bamboo 30 Eco-Friendly Projects to Make for Home & Garden.

Web addresses

https://www.google.com/search?q=bambo+joint+making&sxsrf=AOaemvKLHYwXLAA2McKg14A-

https://www.google.com/search?q=bamboo+furniture+making&sxsrf=AOaemvKtKpbADV0aGJ

Videos

https://youtu.be/eu4e7KSEMAg

https://youtu.be/etvRHyoUKYE

https://youtu.be/bFAdkf4ZTfs

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We would like also to express our appreciation to the TVET instructors and respective industry experts of Regional TVET bureau, TVET college/ Institutes, who made the development of this Teaching, Training and Learning Materials (TTLM) with required standards and quality possible.

The trainers who developed the learning guide

No	Name	Qualification	Educational background	Region	E-mail
1					
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