

INSTRUMENTS

Making Bamboo Angklung

by Barbara Benary

Introduction

The following instructions are the results of my experiments in building and tuning angklung rattles, and may be taken as guidelines for experimentation with bamboo or other materials. I am assuming the reader has a prior familiarity with these kinds of instruments and at least has seen if not actually handled them.

A single angklung, for the purpose here, refers to one unit of two to four tuned tubes—which I refer to as a “rattle”—suspended in a frame with a shared base (Figure 1). There may be two or three octaves represented on a single angklung. In this guide I will use the word “angklung” to refer to a single frame with its two or three tubes. An angklung ensemble may consist of a number of framed rattles, each tuned to a pitch chosen by the maker.

The required tools and materials for building an angklung include: seasoned bamboo, a power drill, chisels, coping saw, vise, knife, quarter-inch dowels, string, and glue (epoxy).

Choosing Bamboo

In Southeast Asia, angklung are made from bamboo stalks that have long segments of a foot or more divided by solid joints visible on the exterior as rings called “nodes.” Each rattle usually has only one segment closed by a node, which forms the closed end. The American-grown bamboo that I have found in California seems rarely to have more than nine or ten inches of length between the nodes no matter if the piece be thick or thin. It is still possible to make larger (lower pitched) angklung using such bamboo with extra nodes on the rattles. The extra nodes will not affect the sound, but it may affect the longevity of the tube.

Nodes are closest together at the base of the bamboo plant and grow increasingly further apart toward the middle of the stalk. Toward the very top they become closer again. The exterior diameter of the tube is largest at the base of the plant and decreases up to the top. The wall thickness, however, is much greater at the bottom than at the middle. This affects the pitch of a given piece

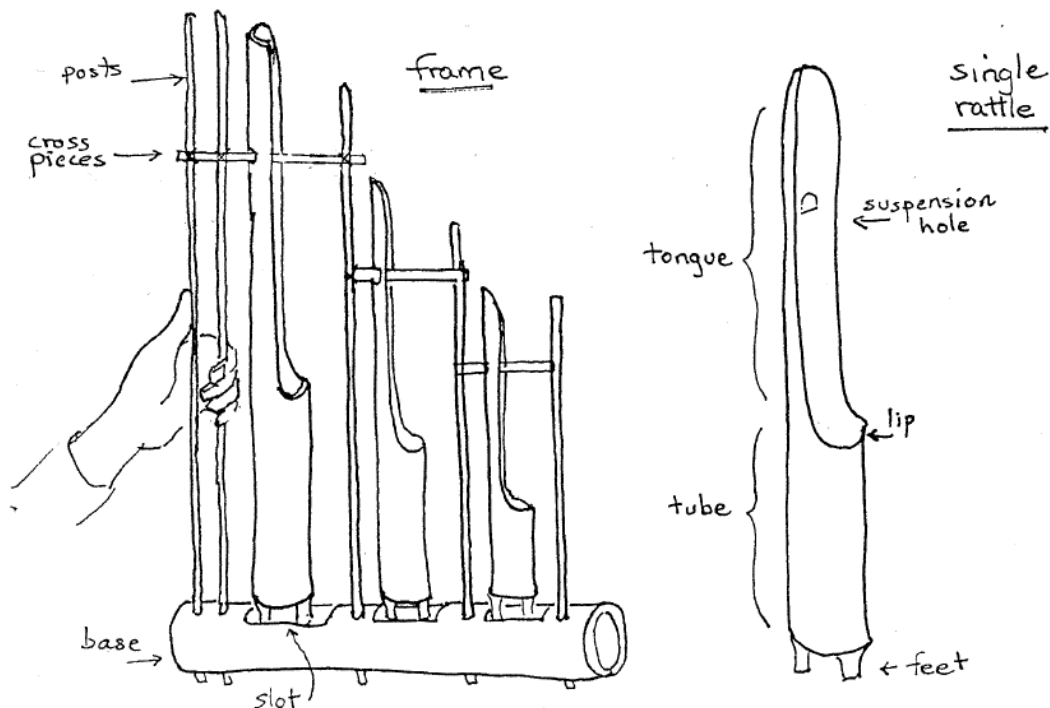


Figure 1. The parts of an angklung frame with rattles and a single rattle.

because pitch depends in part on the volume of the air space within the tube. Given two pieces of bamboo with identical diameters, one from low on the plant and one from higher, a tube made from lower one will produce a higher pitch because it will have less space for air. It is not desirable to use the bottommost part of the plant for angklung building. Save them to make a shakuhachi.

The top of the plant is also undesirable for angklung. From about the middle of the stalk on up, the nodes will show strongly marked indentations from where the leaves grew or a side branch sprouted. These nodal marks are places where splitting is likely to occur. It is better always to use a piece with no such marks.

As with wood, bamboo should be well dried before one attempts to work on it. If you hear the sound of a rifle shot in your house in the dead of night, it may not be vigilantes, but a piece of partly worked bamboo splitting on you.

When bamboo splits, it will always be in the lengthwise direction, along the grain. This characteristic is both a nuisance and an advantage. The node that is to serve as the closed end of the tube must be un-cracked. A crack at the other end, however, may be put to use if it is in the right place. But once a piece of bamboo has started to split where you don't want it to, throw it out.

CUTTING THE RATTLE

When cutting the bamboo, use a saw for cross-grain cuts (I use a coping saw) and a chisel for lengthwise splits, which is much faster than cutting downward with a saw. Always make the crosswise cut first, and then the lengthwise split. The crosswise cut will provide the terminal place for the split you make with the chisel; otherwise you have no

control over how far down your split goes.

A rattle—as I will call each note in a single frame—consists functionally of two parts: the bottom half, which I call a tube, and the top half, which I call the tongue. Each is tuned independently, so the choice of length of the piece you start with is to some extent a visual decision, as some variability is possible. The rattles generally run from about 9 inches to 2 feet in length.

Cut your bamboo to leave about three quarters of an inch below the bottom node. You need this material extending down below the node to cut the “feet” that will be inserted into the base of the instrument. It doesn't seem to matter whether the rattle ends up being right side up or upside down in relation to the way the plant grew.

Size and Length

Estimating the length of bamboo for a rattle of a desired pitch is in part a matter of trial and error. However, here are some clues. If the length of a given pitched rattle is known, the octave above needed for the other tubes (using smaller diameter bamboo) is a little more than half the length of that rattle. The octave below (using larger diameter bamboo) is a little less than twice the length.

Table 1 shows approximate pitches and measurements of some rattles I have made from American bamboo, which has a relatively thicker wall than its Southeast Asian counterparts, and some from my Thai set, which has thinner walls. The number following the note name indicates its octave. (1=middle C octave, 2=the octave above, 3=the octave above that.) All measurements are in inches.

<u>pitch</u>	<u>total length</u>	<u>tongue</u>	<u>tube</u>	<u>circumference</u>
American bamboo				
C#2	11.75	6	5.75	4.85
C#3	8	5.75	2.25	4.85
D#2	11.75	5.75	5.25	4.35
D#3	7.75	5.75	2	4
F2	12.25	7.75	4.25	4.5
F3	6.75	4.75	2	3.85
G#2	10	6.25	3.75	5
G#3	6	4	2	3.25
Thai bamboo				
D1	24	12.5	11.5	6.75
D2	15	9.5	5.5	5.25
D3	9	6.25	2.75	3.85
F1	19.25	10.5	9	6.25
F2	11.25	7	4.25	5.25
F3	7.5	5	2.5	3.5
G#1	18	9.5	8.5	6
G#2	11.25	7.5	3.75	4.85
G#3	6.5	4.5	2	3.4

Table 1. Sizes of pitched rattles in American and Thai bamboo angklung sets.

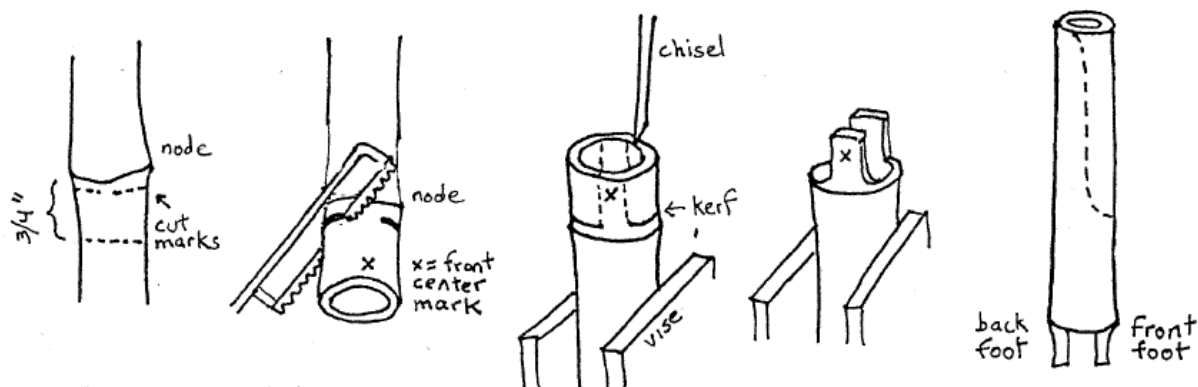


Figure 2. The steps in cutting the feet.

Cutting the Feet

It is advisable to cut the feet first (Figure 2). This will give you a place to tap when tuning the tube and tongue. There are two feet on each rattle. One faces front, the other back. By front I mean the part of the rattle out of which a slice will be cut to form the tongue. The back is the uncut part that is the tongue.

If your piece has a leaf node mark, it might be a good idea to have this node be the front-center line, so that some of it will be cut off in making the tongue, thereby leaving less material that is likely to split. The foot will function whether or not it is cut on a leaf node mark.

Make a mark where the center of the front and back foot will be. Then saw in from both sides just below the node. Saw in a third or more of the way toward the marks. Leave enough uncut material for a foot of about 1/4 inch in width. It is better to cut it too wide at first; one can always take off more material later.

Then brace the piece upside down in a vise and tap down with your chisel from directly above the place where your saw kerf ends. The bamboo should split easily, and the extraneous material will fall away. If the foot ends up too wide, narrow it by sawing in a bit more and tapping off another slice. If you accidentally saw the foot off, it may be glued back in place with epoxy. It will not be structurally as sound, but the foot is not acoustically important to the sound of the rattle.

Cutting the tube and the tongue

The tube and tongue part of each rattle are tuned separately, but should end up in unison with each other. When they are in unison the rattle produces a single, amplified note.

The tube, or lower part, is tuned acoustically as a column of air: its length is the most crucial factor. Once it is cut, you can easily raise its pitch by shortening its length, but it is more difficult to lower it. The tongue works acoustically as a reed, or as half a bar. Length is one factor in determining its pitch, but the relative thickness of top and bottom can be manipulated to adjust the pitch in either direction. Because there is less flexibility in tuning the tube, it is better to cut with the tuning of that part of the rattle as a priority and later adjust the tongue to match it.

The first cut divides the piece into tongue and tube (Figure 3). The location of this cut is partly aesthetic and partly acoustic. Remember that the length of the tube part pretty much fixes its pitch, and if you cut it too short the piece will have to be used for a higher note.

Visually the proportions of tube to tongue look best at anywhere between 1:1 and 2:3. The proportion increases as the pitch gets higher: tongue longer, tube shorter. With rattles pitched below middle C, the proportion is 1:1, or in fact, the tongue may be shorter than the tube.

If you have a specific pitch in mind, it is better to overestimate the required length of the tube, and to place the first cut too high. It can always be cut down lower later to raise the pitch. Mark the position of your first cut at the front center (aligned with the front foot).

After you have identified the placement of your first cut and marked it, place the piece in the vise horizontally with the front foot facing upward. Begin your cut at the front center. Saw straight down and about halfway through the diameter.

Then trace the edges of the cut up the grain to the top of the piece, and mark the two places on top. Reposition the piece in the vise vertically. Gently tap down at the marked spots with the chisel until the bamboo cracks and half of the upper part falls away. Now you may begin fine tuning the tube and tongue.

Imperfections

Imperfections in a given piece of bamboo do not necessarily render it unusable. In some cases you can plan your building to make use of or negate certain qualities that may otherwise hinder the piece of bamboo from functioning as an angklung. If there is a node in the middle of the length of bamboo, for instance, you can make it the dividing point between tube and tongue, and make the first cut on the node itself. Then simply remove the middle material of this extra node with a knife.

If you have a piece of bamboo that has a good node at the foot end, but is partially split at the other end, it can still be used to create a rattle. Plan your first cut so that the partially split end will ultimately form one side of the

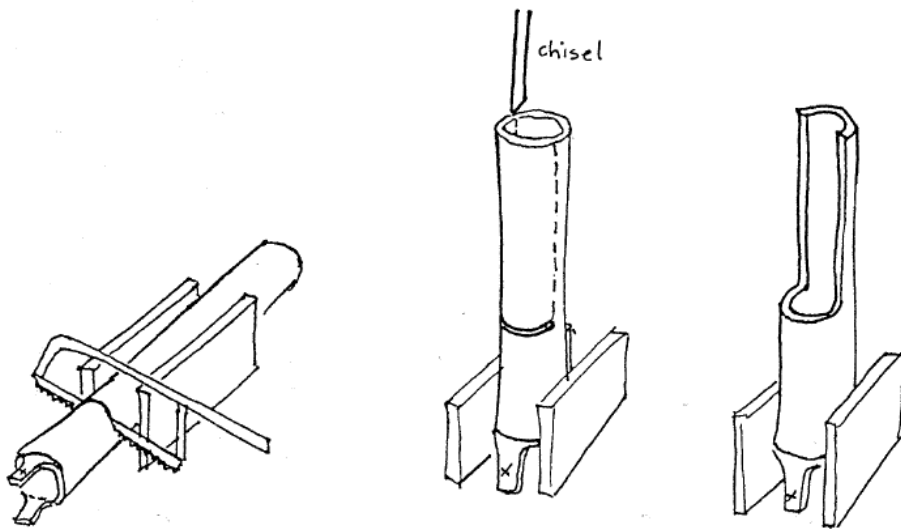


Figure 3. Cutting the tongue.

tongue. Just be careful not to exacerbate the split when cutting the feet and making the first cut.

TUNING THE RATTLE

Distinguishing Pitch

Most likely if you tap various parts of the newly cut rattle, you will hear two different pitches. One of these pitches is produced by the tube, and the other by the tongue. The first task is to figure out which is which.

Hold the rattle at a point a bit above the middle of the tongue and tap it on or between the feet. This is approximately how the instrument will work when suspended in its frame. Then try one or all of the following strategies to distinguish which pitch is coming from which part of the instrument:

While tapping, lay a finger on top of the tongue. This stifles tongue pitch and you should hear more tube pitch.

Tap alternately at the top of the tongue to hear more tongue pitch and at the lip of the tube to hear more tube pitch. Don't block the opening of the tube in order to hear more tongue pitch. Probably you won't hear anything.

After knocking all bamboo dust out of the tube, blow across the opening to hear its pitch. If the pitches you hear are within your vocal range, try singing a sliding note next to and across the tube (without blocking the opening). When you match the tube's pitch, it will resonate.

Raising Tube Pitch

To raise the pitch of the tube, cut slices off of the lip to make the tube length shorter. Make the cuts parallel, and small if you are close to the pitch you want. Chisel off each slice with a gentle tap and test the pitch again before cutting further. If you're not sure whether the tube needs to be just a little higher, wait until after the tongue is tuned to make that last slice.

If you cut the lip at the node and want to keep it there,

make your initial cut slightly above the node line. Your tube is now capped at both ends. Chisel a small hole through the top node, making a semi-closed tube whose pitch will be lower than an open tube. To raise the pitch, knock out more of the node material or, if need be, shave down the inside of the thick node walls.

There is really no going back if the tube pitch gets too high. I have tried some cut-and-paste remedies: gluing back the last slice I cut off, inserting material into the inside edge of the top opening, etc. If the epoxy holds, this material will lower the pitch a bit, but I don't recommend these measures; they all look sloppy.

Tuning the Tongue

Here one is fortunate in having a lot of leeway to either raise or lower the pitch that emerges after the initial cutting. Weight and thickness of the tongue determine its flexibility and thus its pitch. The heavier (more rigid/less flexible) the tongue is, the higher its pitch. A second factor is length. The longer the tongue is, the lower its pitch. Thus one raises the pitch by removing material from the end of the tongue and shortening it. One lowers pitch by removing material from the sides and base of the tongue, thereby lightening it and increasing its flexibility.

Raising Pitch

For gross tuning, if you are several notes too low for desired pitch, cut slices off the tip. Don't worry too much about overshooting the mark since it is easy to lower the pitch again. To fine-tune the tongue, chisel the very tip thin, particularly at the corners.

Lowering Pitch

You must remove material from the middle and base of the tongue in order to lower its pitch. Generally this is done

by chiseling strips off the sides down to the lip of the tube. Be sure to saw in before chiseling down to reduce the risk of splitting the tube as well. To fine-tune, take small slivers off the sides of the tongue, or else cut away the edge at the base. For very large rattles, you can also chisel the lower wall of the tongue to make it thinner.

Take note that when you cut the suspension hole, the pitch of the tongue will be lowered slightly on lighter pieces of bamboo.

ASSEMBLING THE ANGKLUNG

Base Tube

The tube at the base of the rattle frame functions only partially as a resonator, and does not need to be tuned. Its major purpose is to support the entire frame, and to provide the slots within which the feet of the rattles move and knock against the hard surface to generate sound.

In Balinese and Javanese angklung, the base is usually an open-ended tube of bamboo of sufficient length to allow for the spacing a movement of the two, three, or four rattles that fit in the single frame. However, the base need not even be a tube. I have an angklung set I believe to be from Thailand in which the base takes the form of a wooden canoe, and the rattle feet knock against wooden blocks set in the trough at front, rear, and middle.

In my experience, the canoe design appears to have a distinct advantage over the bamboo tube design (Figure 4). It is virtually indestructible, whereas I have found that bamboo tubes, after being drilled and chiseled in many places for the feet and frame sticks, are structurally weaker and very prone to splitting. Split base tubes give the angklung a bad sound and can't be used.

Despite this disadvantage, if you wish to construct a bamboo tube for the base, here is how to do it.

Choose a tube about the same diameter as the largest rattle that will go into the frame. In length, allow a slot for each rattle that will be about $\frac{1}{4}$ inch longer than its

diameter. Also allow about $1\frac{1}{2}$ inches of length for post holes at each end and between rattle slots. Make these spaces slightly bigger for large, low-pitched angklungs.

First mark where the postholes are to go: one at each end, and one to go between each rattle slot. Thus a two-rattle frame needs three postholes, a three-rattle frame needs four. My sturdy Thai set includes an extra posthole at the end where the largest rattle hangs, placed about an inch away from its partner. The double posts at this end enable the player to get a firmer grip on the frame.

Postholes and slots are all in a line, following the grain of the bamboo. After they are all marked, use a $\frac{1}{4}$ inch drill and put holes through for each post, and at each end of where each slot will be.

Since the posts must go entirely through the tube, next mark the emerging postholes on the opposite side of the tube and drill them. As a safety precaution to keep the drill from hitting and possibly cracking the already drilled side, place a piece of wood inside the tube.

Slots

The chiseling of the slots is the process in which the danger of cracking the base tube is greatest. Holes have already been drilled at either end of the slot. Next chisel out the strip between these holes, then enlarge the slot as needed with a chisel or knife (using a knife is safer, regarding splitting).

Frame

Once the postholes and slots are created, it is time to affix the posts that will support the rattles. I prefer to use quarter inch dowels for the vertical posts of the frame. One can also use bamboo sticks, sold in garden supply stores as tomato sticks, but these are usually a little crooked.

The post or posts to be held in the player's hand should extend through the base and up to the height of the tallest rattle in the frame. The other posts should each extend to slightly above the height of the node of each rattle

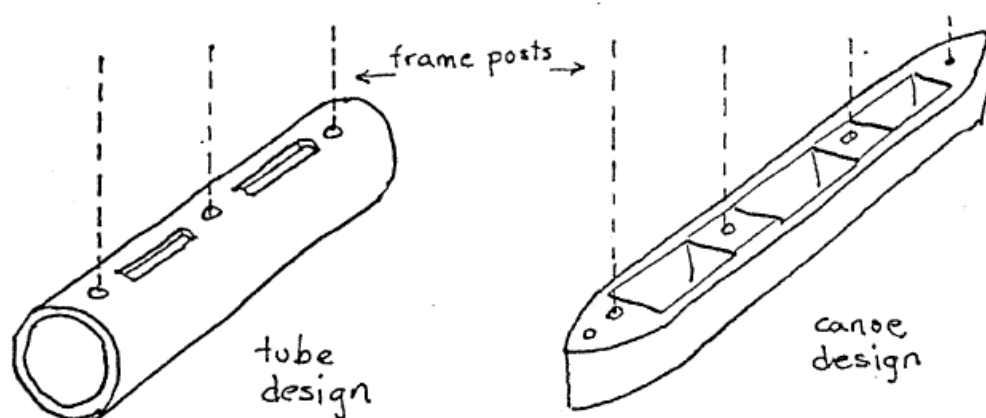


Figure 4. Designs for the base of the angklung.



Figure 5. Suspension hole and notched crosspiece.

in the frame, so that the crosspiece that passes through the suspension hole may be attached at the top of the post. Glue the posts into the base holes with epoxy.

Crosspieces must extend a bit more than the length between each post and the next. This allows enough overlap to the posts on each side. Crosspieces must be notched at the point from which the rattle is to hang (Figure 5). This notch can be triangular or square. With the rattle in place, attach the crosspiece to the posts on either side using thin string and glue.

Place the crosspiece at a height that enables the rattle to swing above the base with its feet in the slot. The rattles in the frame go from largest (on the side the player will hold) to smallest. They “face” out, away from the player—that is, the cut side of the rattle faces away from the person holding it.

Suspension Hole

The suspension hole allows the rattle to be placed into the frame of the angklung. To create the suspension hole, start by finding the point on the tongue that allows the greatest resonances when you hold the rattle at that point and strike it. It is usually a little above the middle of the tongue, but may even be below that point.

After you have found it, mark this point on the outside of the tongue and drill through using a ¼ inch drill bit from the outside to avoid chipping the outer skin of the bamboo.

The size and shape of the hole will depend on the type of crosspiece in the frame from which it will hang.

MAINTENANCE AND REPAIR

Bamboo is an organic material. Changes in humidity, particular too much dryness, are likely to make it crack. Avoid dry, overheated indoor storage. I don’t think actual temperature is a problem, but sudden temperature changes are probably bad.

A split rattle may sometimes be revived. In the case of cracks along the tongue (the most common place), glue the crack back together with epoxy and hold it in place with masking tape. In an emergency the tape alone will often do. Cracks that appear along the tube extending down from the lip may also be repaired with epoxy if they haven’t extended too far down. Once the bamboo opens up, you should just throw it out.

Because of the fragile nature of the organic material, it may be worthwhile for the angklung maker to experiment with various synthetics, either for the base or for the individual rattles as well. I have yet to try my hand at PVC or ABS or the various plastic-impregnated organic fiber materials, but they all present interesting possibilities. ▀