Aluminum Bonangs

by Paul Dresher

The bonang family of instruments in Java functions generally as the primary group of instruments for the elaboration of a nuclear or trunk melody. The instruments have a two octave range, though usually only five tones per octave are used, even in pelog. In Java, there are two or three instruments of different ranges in this family, and there is one of each in both the slendro and pelog tuning systems. These are, from low to high in pitch, bonang panembung, bonang barung, and bonang panerus. Each adjacent instrument has an overlap of one octave with its neighboring instrument. There is only one of each range of instrument in the orchestra, and often the bonang panembung is absent.

In design, the individual pitches are essentially small gongs, but instead of being suspended vertically, they rest on their edges and look like a collection of kettles. They are essentially modular in design, as the individual kettles may be arranged in any order to suit the particular piece to be played.

In these designs, aluminum discs will be substituted for these kettles since the technology for making these kettles in the Javanese fashion is virtually unavailable in the west. The following designs are an adequate duplication of both the timbre and the playing technique for these instruments. These designs will be for instruments with seven tones per octave. The case specifications will be given only for the bonang barung. For the other instruments one may follow the identical processes of construction, merely substituting the different dimensions required by the various sizes of the discs. Of course, a variety of case designs and pitch numbers are possible: these are only one possibility.

BONANG MATERIALS

Materials for the bonang barung case

1) Sides—two pieces of 2×3, 88″ long.
2) Ends—two pieces of 2×3, 21″ long.
3) Legs—four pieces of 4×4, 18″ long.
4) Disc stand support strips—two pieces of 1×1, 81″ long.
5) Center support—one piece 1×4, 84″ long.
   one piece 1×2, 81½″ long.
6) 8d finishing nails, 4d finishing nails, glue.

Materials for the disc stands

1) Seven squares of any wood material at least ¾″ thick, side of square 11¼″. Eight squares with a side of 9½″.
2) 27 linear feet of ½″ hardwood dowel.
3) One square foot of ¼″ soft neoprene or similar material.
4) 3d finishing nails.
5) Duct tape or other high quality tape, or rubber hose which fits snugly around a 3d nail.
6) Approximately 200 inches of strips of neoprene or foam rubber for padding the disc stands and the case.

Materials for aluminum discs—See following charts

SPECIFICATIONS FOR ALUMINUM DISCS

These charts present one possibility for a set design, many others are possible.

For Bonang Barung

Pitch Area	*Width of Disc*	*Thickness of Disc*
C	11	.090 (3/32″)
D	10¾	.090
E	11	.110 (7/64″)
F	10½	.110
G	10½	.090
A	10⅜	.090
B	10¾	.090
C	9	.090
D	9	.110
E	8½	.090
F	8½	.110
G	8¼	.090
A	8⅜₁₆	.110
B	7½	.125 (1/8″)
C	7	.125

For Bonang Panerus

Pitch	*Width*	*Thickness*
C	9	.110
D	8½	.090
E	8	.100
F	7¾	.100
G	7½	.100
A	7¼	.110
B	7	.110
C	6½	.125
D	6¼	.125
E	6	.125
F	5¾	.125
G	5½	.125
A	5¼	.125
B	5	.125
C	5	.125

One can easily see from the variety of irregularities both within and between the charts that a particular pitch may be obtained from a variety of combinations of disc diameter and thicknesses.

MAKING THE DISC STANDS

1) Cut the 15 disc stand basses, seven squares with an 11¼″ side, and eight squares with a 9½″ side.

2) Take each individual finished aluminum disc with the nodal holes drilled and pair it with an appropriate base. The seven lowest pitches will be on the 11¼″ bases, the higher 8 will be on the 9½″ squares.

3) Center the disc in the center of the square and mark the disc's nodal points on the base. Place the disc such that the line between the nodal holes is parallel to two of the base's sides.

4) Although only two holes are necessary to anchor each disc, the disc will be further stabilized by an additional two posts which require no nodal holes in the disc but are located under the nodes. Their placement is determined as follows:

a. Draw a line on the base connecting the points of the disc's two nodal lines;

b. From the center of that line, draw a line perpendicular to the first line;

c. Measuring out along this line on each side of the center, mark a point the same distance that the original two nodal holes are from the center.

5) Bore a hole at each of these four points.

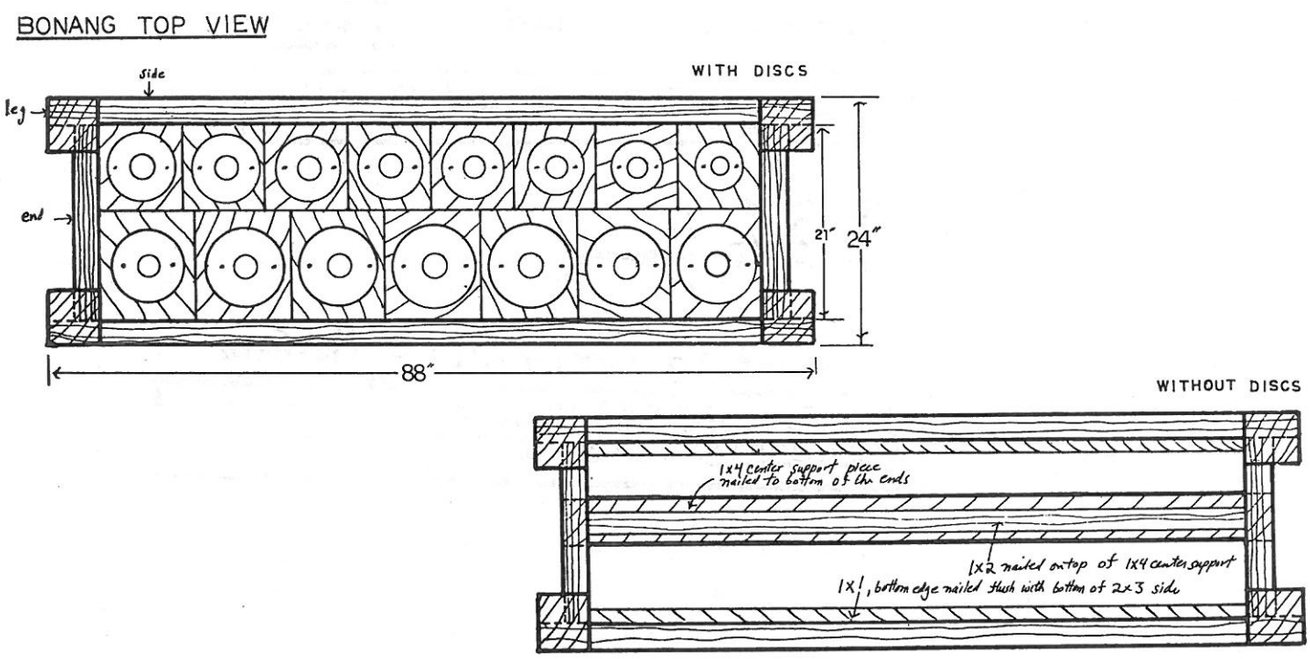
6) Cut four 5″ lengths of ½″ hardwood dowel for each square and glue them into the four holes in the square. Set the disc on top of the dowels to make sure the dowels are in straight and even in height. Always keep a disc and its respective stand together because a disc will fit only on the stand made for its particular nodal holes.

7) With a razor blade or sharp strong scissors, cut the ¼″ neoprene into squares with a ⅜″ side. When the dowels have dried into the bases, take a 3d finishing nail and drive it through the neoprene into the top of the dowel. Place the disc over it and find the point on the opposite dowel where the nail should be driven. This should be as close to the center of the dowel as possible. Drive the nail through the neoprene square leaving the top of the nail protruding about ⅜″ above the neoprene square.

8) Cut ⅜″ strips of duct or gaffers tape and wrap about a ¾″ section of the tape around the exposed nail. This will prevent buzzing between the nail and the disc.

9) Take a tack (not a nail) and tack a neoprene square to the other two dowels. Be sure to drive the tack deep enough so that it is recessed far enough in the neoprene that it will not come into contact with a disc resting on top of it. These two dowels just provide support from underneath but do not anchor the disc in place.

10) Place the disc over the four posts. It should rest freely, without pressure between any two nails. If there is contact, try bending the nail (there should be enough flexibility for this), until the disc sits freely. Any tension between the nails will mute the tone of the disc.



TUNING ALUMINUM DISCS—The theory

There are a few general criteria which affect the pitch of a particular disc.

1) *Diameter*—the greater the diameter, the lower the pitch.

2) *Thickness*—the thicker the disc, the higher the pitch.

3) *Height and diameter of the boss* (the nipple pounded into the center of the disc)—the higher the boss the higher the pitch; the greater the diameter, the lower the pitch.

4) *Arch of the top of the disc*—the more the arch (usually the result of pounding the boss), the higher the pitch. The reverse effect (inverting the arch or dishing from the rim to the boss) also produces a rise in the pitch.

5) The useable tuning range of a disc of a given diameter and thickness is easily a 5th and sometimes as much as an octave. The extremes of a disc's range are usually marked by a thin tone, strong irregular partials, or a short sustain. There is generally a smaller pitch area in which the disc is particularly resonant.

6) The charts given previously were taken from one set of instruments. Many other ways to achieve the same pitches are possible so it is unnecessary to attempt to duplicate the charts exactly. It is better to work with the materials which are most available. (One may also want to choose on the basis of aesthetic criteria such as timbre between two discs of the same pitch but different dimensions.)

TUNING ALUMINUM DISCS—The practice

1) Take a large block of wood and at its center carve or bore a hole about 2" deep and 2–3" in diameter. This piece will be used in forming the boss in the pounding process.

2) On a band saw, cut out the aluminum discs to the various diameters. Take care to make the discs relatively circular.

3) Take a disc and place its center over the center of the bored piece of wood. Starting at its center, pound, with a ball peen hammer, a nipple or boss into the disc. This process is very loud so one should plug one's ears. The depth and diameter of the boss to a large extent determine the pitch of the disc. The boss diameter generally varies from 1¼" to 2½".

4) The more one pounds, the higher the pitch. Make the boss symmetrical around the center of the disc. The boss acts to give a coherent tone to the disc. It seems to function well between a height of around ¼" to 1", at which point the aluminum may crack or strange partials may creep in. Keep the bulk of the rise of the boss within about a 3" diameter about the center of the disc. The whole disc will tend to cup towards the boss and this also greatly raises the pitch. However, if the cupping becomes too great, the disc may warp which gives a strange sound indeed. One must then pound the warp out or discard the disc, unless one wishes to utilize that sound.

5) To lower the pitch, simply turn the disc over and pound around the circumference of the boss. The pitch goes down very fast as one removes the cup shape from the disc. However, if one pounds so far that the cup is inverted (while still retaining the original nipple), the pitch goes up again rapidly.

6) The discs are quite sensitive to tuning. A correctly placed stroke (generally near the edge of the boss) may raise or lower the pitch a third. Strokes on the boss itself are less sensitive and are thus more useful for fine tuning.

PAUL DRESHER is best known as a composer-performer of electronic and multi-media works. He is a collaborator in George Coates' "The Way of How" (see review by Bonnie Barnett, this issue), and he also teaches at the Cornish Institute in Seattle, Washington.

This article is excerpted from Dresher's Masters Thesis. It documents instrument building techniques evolved during a period of research with Daniel Schmidt.

LOCATING NODAL POINTS IN BOSSED DISCS

There is no strict formula for determining the location of the nodal points since the disc is stressed unevenly due to pounding of the boss.

1) Mark a point ¼ to ⅓ of the diameter in from the edge of the disc. Do the same 180 degrees opposite on the disc (on the same side).

2) Set the disc on top of a padded dowel at one of these two points. Pinch the other point between the thumb and a finger at the point on the opposite side. Repeatedly strike the disc while moving one's pinching point and the point of suspension on the dowel until the maximum sustain time is obtained. Mark these points on the disc, being sure that they are still 180 degrees opposite each other. Drill the two nodal holes at these points.

CONSTRUCTING THE BONANG CASE—(one possible design, many others will work too)

For other sizes of bonang, substitute dimensions based on the size of the disc stands used. The length and width will change but the height will remain the same.

1) Cut two pieces of 2×3, each 88" long. These will be the lengthwise sides.

2) Cut two pieces of 2×3, each 21" long. These are the ends and should be only slightly more than the sum of the two disc stand sides. In the case of the bonang, it is a bit more than 11¼" plus 9½".

3) Cut four pieces of 4×4, each 18" long.

4) Mark two lines on two adjacent sides of each 4×4, perpendicular to the length, 9 inches from the bottom end. Measure the exact width of the 2×3 (should be about 2⅜") and mark another two perpendicular lines (one on each face) that distance above the first lines. Measure the thickness of the 2×3 (about 1⅜") and cut out the wood between the lines on both faces to that depth. The cutting may be done on a table saw with dado blades, band saw, or with a hand saw, chisel, and file. Cut inside the lines to be sure the inserted piece will fit tightly. Repeat this operation on all four legs.

5) Using 8d finishing nails, glue and nail the sides to the 4×4 legs. Be sure the ends of the sides are flush with the legs.

6) Nail and glue the ends to the side/leg assemblies. Be sure the ends abut the inside of the sides on all four corners. See drawings.

7) Take the two 81" 1×1 strips and nail and glue them on the inside of the sides, one surface of each being flush with the bottom of the side.

8) Nail and glue the 84" 1×4 on the bottom of the ends so that it will be under the joint between the two rows of disc stands. Its center should be about 12¾" in from one side.

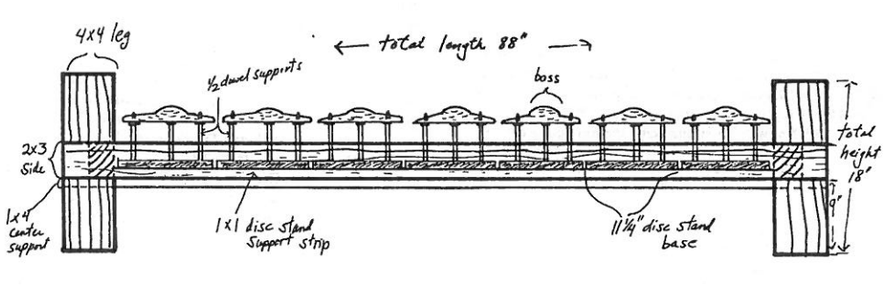
9) Nail the 81½" 1×2 on top of the center of the 1×4, between the two ends. The top of this 1×2 should be at the same height as the top of the 1×1 strips. Its center should also be under the joint between the two rows of disc stands.

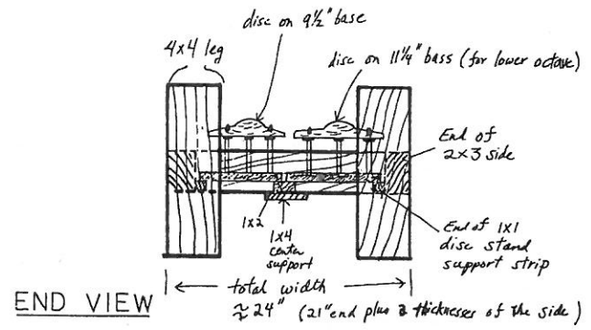
10) Cut thin strips of foam rubber or neoprene and line the top of the two 1×1 and the 1×2 strips. Attach them with staples or tacks. Be sure the staple or tack is well recessed below the top of the foam material. This padding helps reduce the "clunk" of striking the disc from being transferred to or amplified by the case.

11) Place the completed disc and stand assemblies into the case and arrange them in the order desired.

BONANG MALLETS—One may experiment with using various available mallets, such as marimba mallets, to find the preferred sound.

BONANG SIDE VIEW





END VIEW

DISC STAND ASSEMBLY