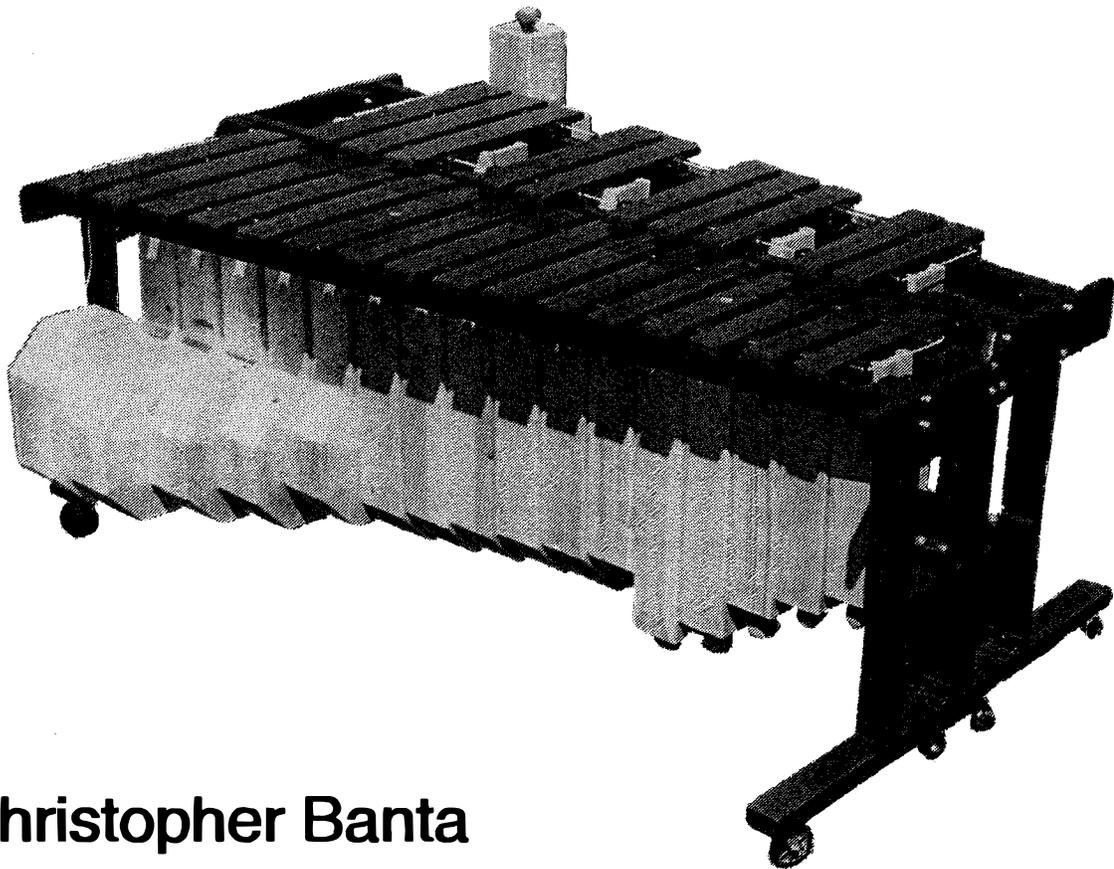


Melodic Bar Percussion Science

# Semi-Contra Bass Marimba

Engineering Design Specification

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**Christopher Banta**

Doc. No. CCB-1033

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Document History

Initial release: October 1994

# CONTENTS

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|  | Page |
|--|------|
| 1. Introduction                              | 5    |
| 2. Instrument Description                    | 7    |
| Photo - Front View                           | 8    |
| Photo - Rear View                            | 9    |
| Photo - Right Side View                      | 10   |
| Photo - Left Side View                       | 11   |
| 3. Instrument's Purpose                      | 13   |
| 4. Instrument Specifications                 | 15   |
| 5. Orthographic Projections                  | 17   |
| Top View                                     | 18   |
| Front View                                   | 19   |
| Side View                                    | 20   |
| 6. Bar Data                                  | 23   |
| 7. Resonator Data                            | 23   |
| 8. Miscellaneous Data                        | 25   |
| APPENDIX A Resonator Data                    | 29   |
| APPENDIX B Design Data and Construction Info | 57   |
| APPENDIX C Materials List                    | 71   |
| APPENDIX D Miscellaneous Data                | 73   |

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# 1 INTRODUCTION

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This Engineering Design Specification describes the information used in the design and construction of a class of mallet percussion instrument known as a "Semi-Contra Bass Marimba."

This document is divided into two sections. The first section, which is sub-divided into eight chapters, contains information relevant to the instrument's design and its components. The second section, in appendix form, contains pure engineering data necessary to the instrument's function and fabrication.

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## 2 INSTRUMENT DESCRIPTION

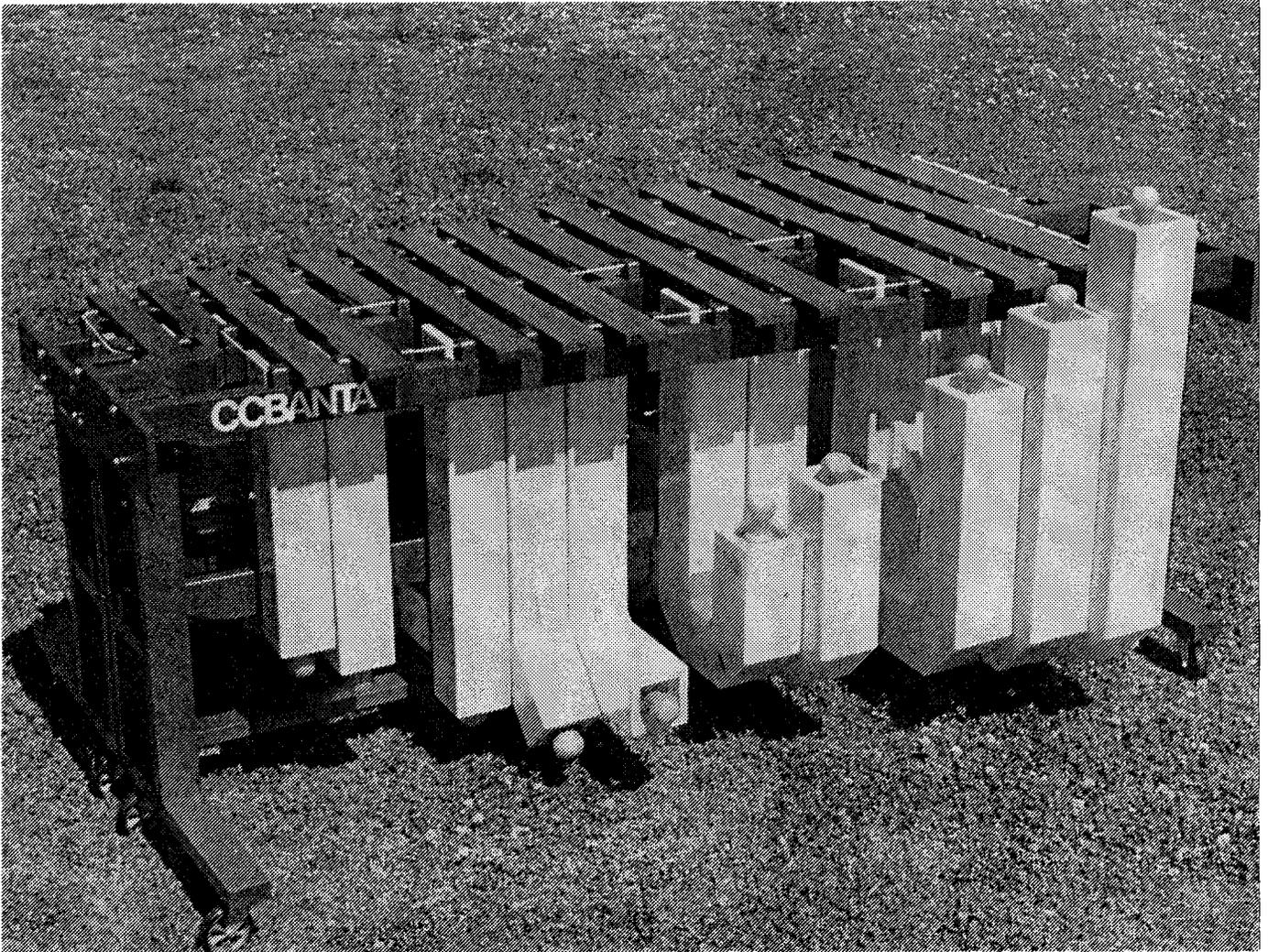
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The following is the Engineering definition of the Semi-Contra Bass Marimba:

*The Semi-Contra Bass Marimba shall be a 26 note, diatonic scale, bar percussion musical instrument starting on the pitch of E [41.2 Hz]. The top note shall be the pitch of F [176.6 Hz]. Each bar shall be made out of African Padouk, and have its own corresponding quarter-wavelength resonator with an adjustable stopper at the closed end. Resonators, on the naturals side of the instrument, shall be mitered as required to meet the 35-1/2" playing height and shall fit within the confines of the frame. Resonators, on the accidentals side, shall use limited mitering that allows them to project upward - similar to organ pipes. Both bars and resonators shall be held in precise alignment with each other using a support frame that is capable of separation into two halves. One half shall contain the naturals. The other half shall contain the accidentals. The whole instrument shall be made mobile through the use of rubbers casters.*

## 2 INSTRUMENT DESCRIPTION (continued)

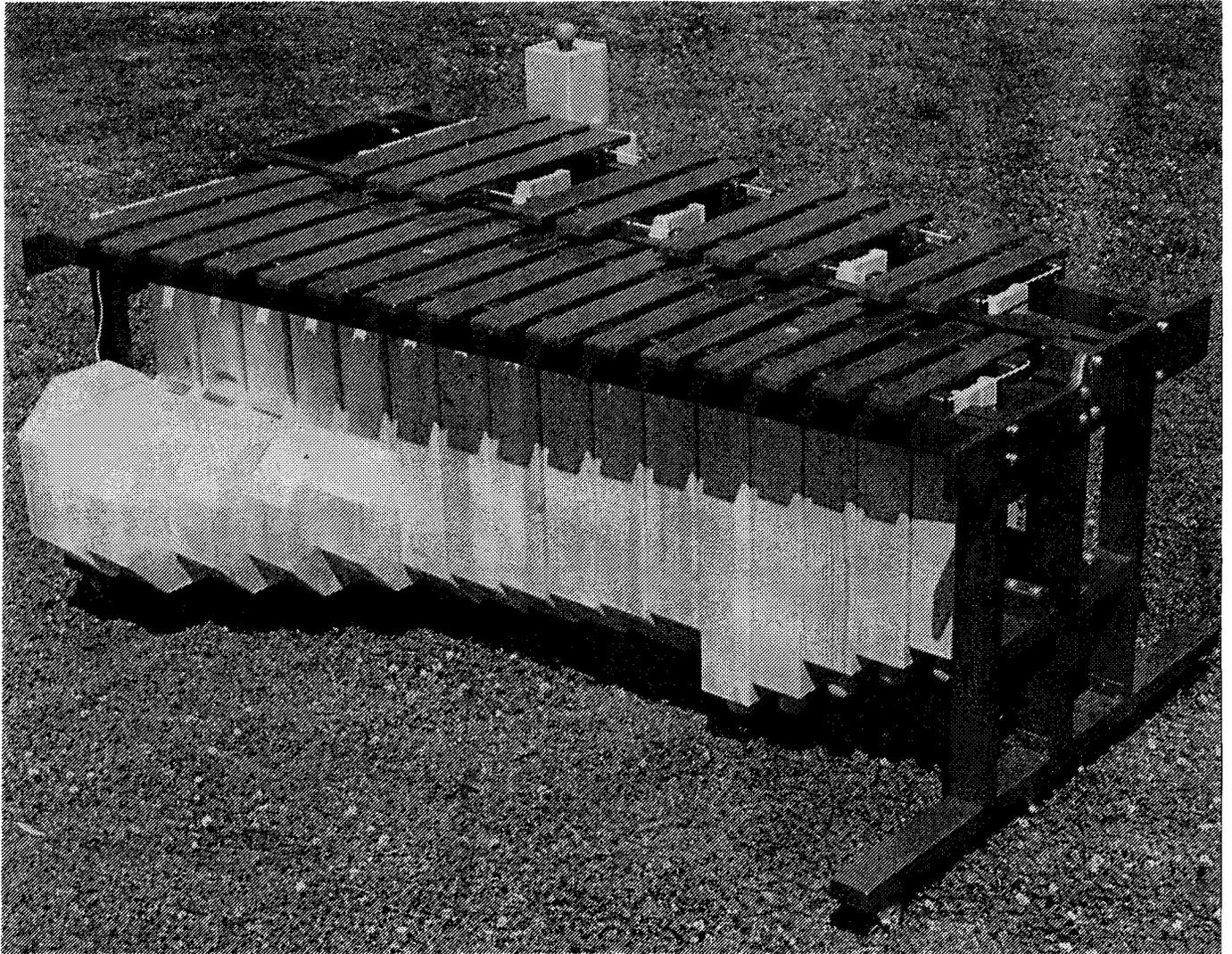
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Semi-Contra Bass Marimba (Front View - audience side)

## 2 INSTRUMENT DESCRIPTION (continued)

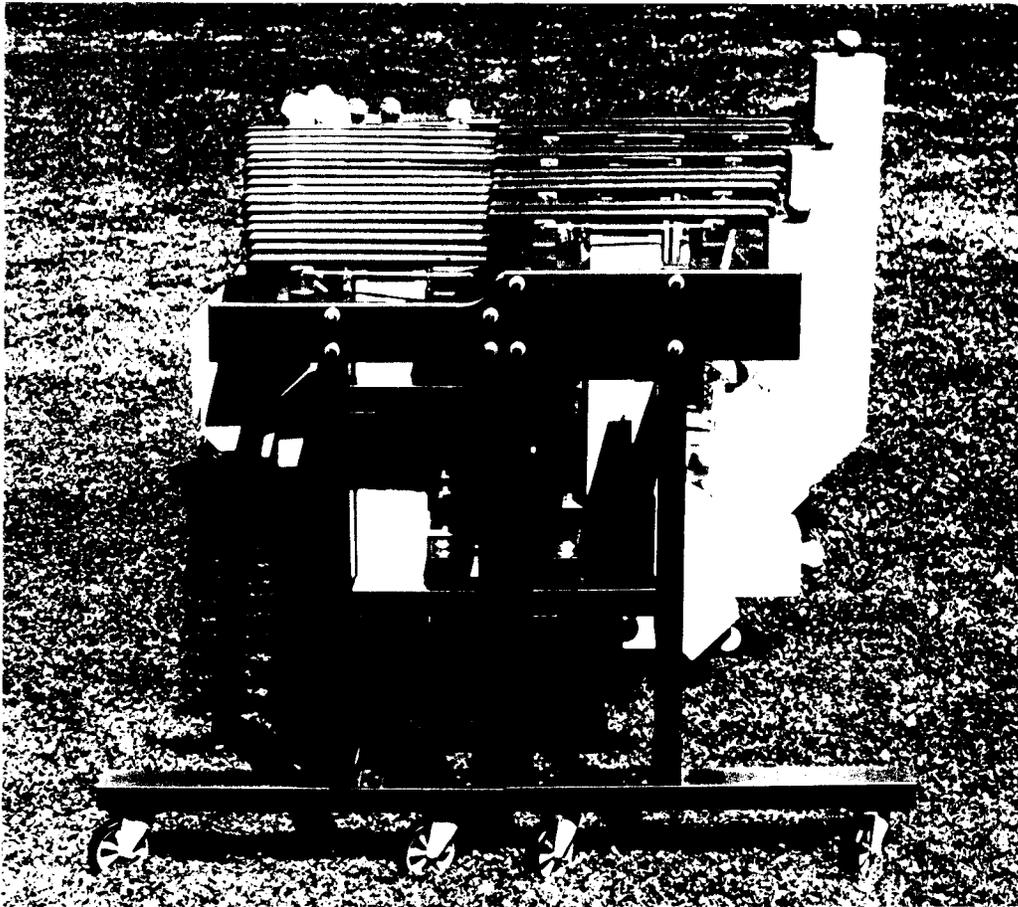
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Semi-Contra Bass Marimba (Rear View - performer's side)

## 2 INSTRUMENT DESCRIPTION (continued)

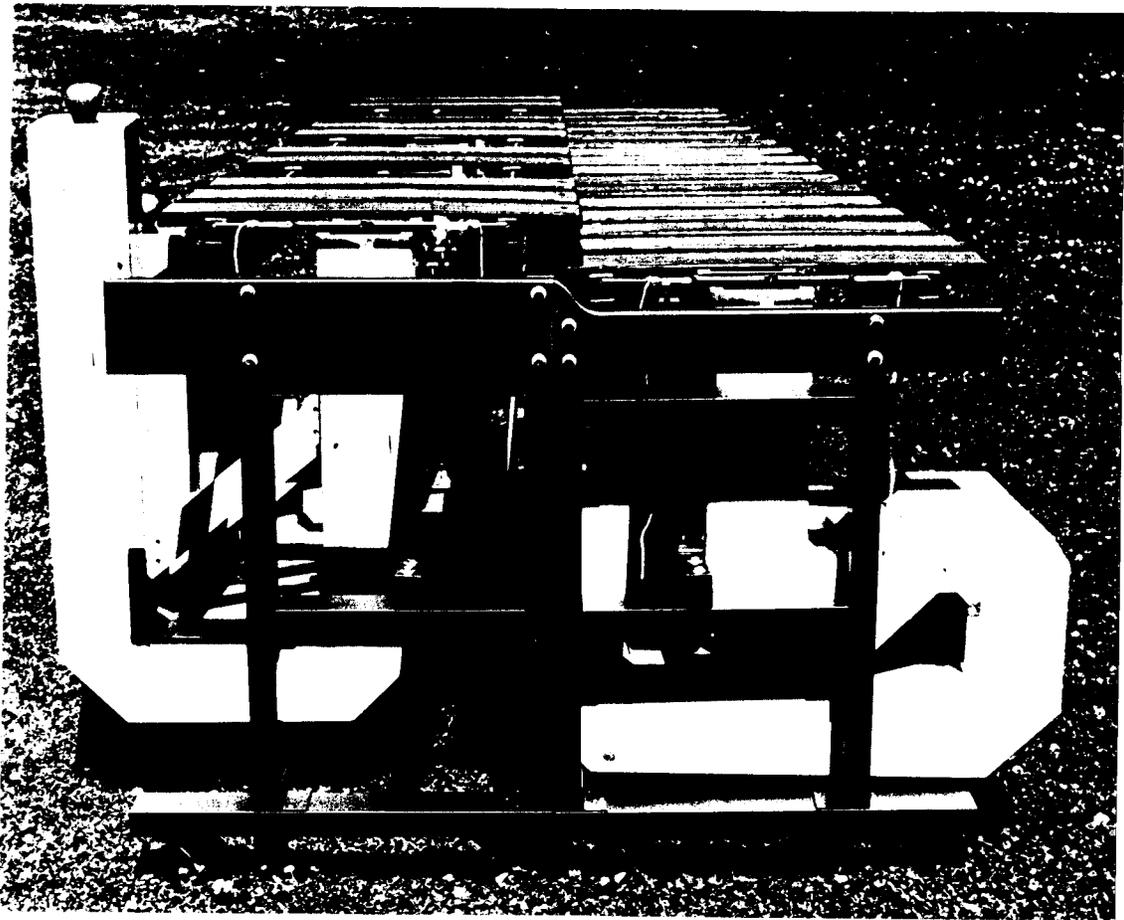
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Semi-Contra Bass Marimba (Right-Side View - high end)

## 2 INSTRUMENT DESCRIPTION (continued)

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Semi-Contra Bass Marimba (Left-Side View - low end)

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### 3 INSTRUMENT'S PURPOSE

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#### Events Leading Up To The Instrument's Design

Two of my earlier bass marimba projects (Extended Bass Marimbas built in 1980) were in the hands of Emil Richards, for his studio and recording work, and David Ahlstrom, for his Bay Area Youth Opera (BAYO) project. I only had the Contra Bass Marimba (also built in 1980) at the time, which unfortunately has no notes above cello C. This was okay, but the additional pitches [above cello C] were really necessary to show an instrument off to interested parties. Since a few years had passed with no construction activity, I was starting to get the *itch* to build another marimba. Even though I had been through some pretty good construction successes with my earlier instruments, I felt it was time to improve on the technology of the 1980 Extended Bass Marimba. Therefore I started designing a new *semi* contra bass marimba. (Since contra bass C is 32.7 Hz [C1], the term *semi* implies that the low-end range of the instrument does not go down as low.) The bottom note in this case would be E1 (EEE), or the same as the bottom note on the string bass.

#### Pitch Rationale

The pitches used in the Semi-Contra Bass Marimba follow the traditional Western "equal-tempered" scale of twelve pitches to the octave - known as the "chromatic" scale. This is derived from the mathematical factor of  $1.0594631$  ( $12\sqrt[2]{2}$ ) using 110Hz (having been assigned to the note of "A" from the A-440 pitch standard) as the starting point for determining the remaining twelve pitches.

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## 4 INSTRUMENT SPECIFICATIONS

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### Physical Characteristics

|         |                             |                 |
|---------|-----------------------------|-----------------|
| Height: | 35-1/2" (Naturals)          |                 |
|         | 37-1/2" (Accidentals)       |                 |
|         | 45" (Top of FFF# Resonator) |                 |
| Depth:  | 55"                         |                 |
| Width:  | 90"                         |                 |
| Weight: | Accidentals                 | 195 lbs.        |
|         | Naturals                    | <u>255 lbs.</u> |
|         | Total                       | 450 lbs.        |

### Materials

|             |  |
|-------------|--|
| Bars:       | African Padouk   |
| Resonators: | White Pine   |
| Frame:      | Rectangular Extruded Aluminum, White Fir and Clear Fir |

### Musical Characteristics

|                  |                     |
|------------------|---------------------|
| Number of Notes: | 26                  |
| Tuning:          | Equal Tempered      |
| Pitch Standard:  | A-440 Hz            |
| Pitch Range:     | E1 to F3 (EEE to F) |
| Frequency Range: | 41.20Hz to 174.61Hz |
| Musical Range:   |                     |



## 4 INSTRUMENT SPECIFICATIONS (continued)

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### Instrument Assembly

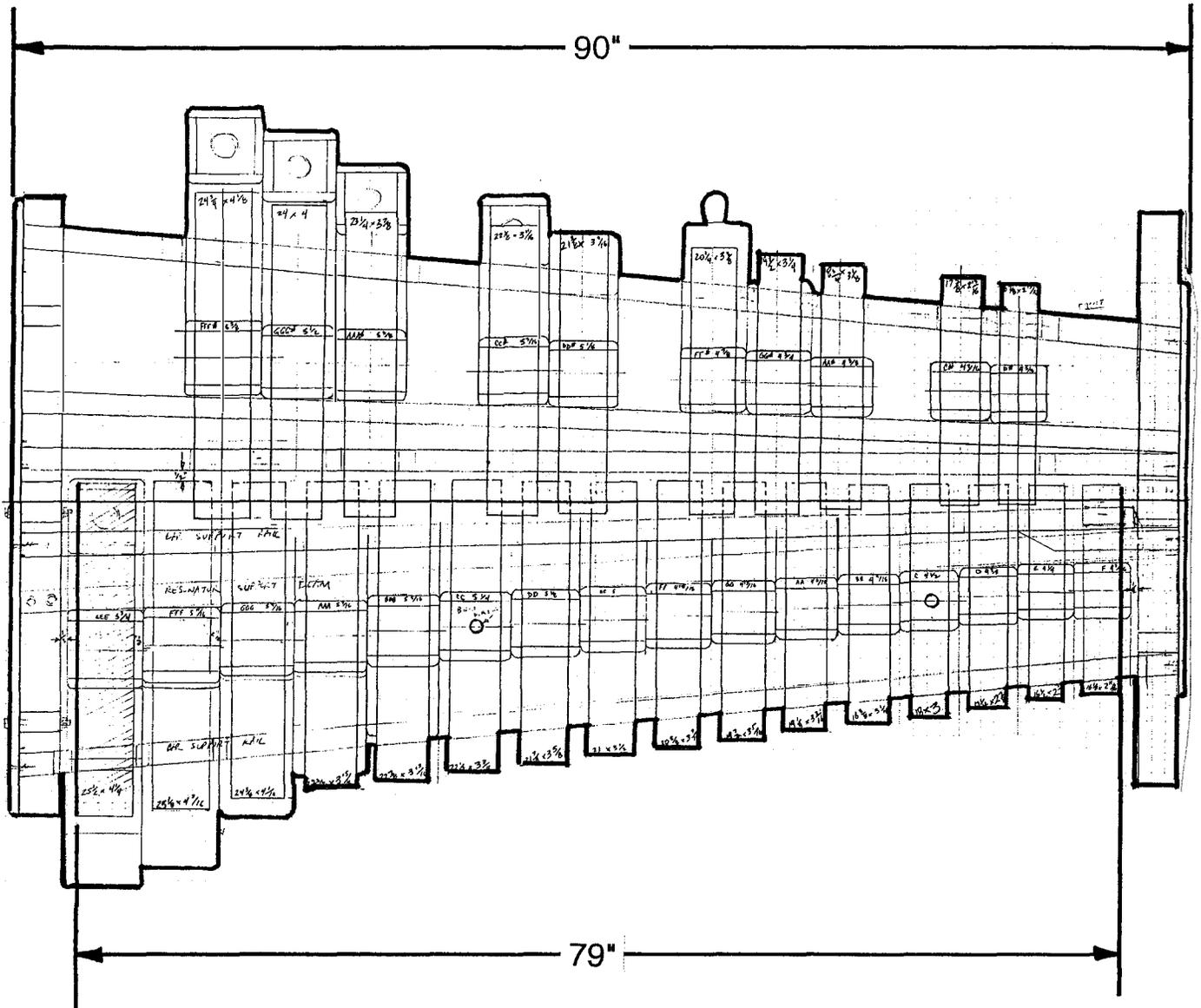
|                          |            |
|--------------------------|------------|
| Completion Date:         | March 1985 |
| Total Design Time:       | 2 weeks    |
| Total Construction Time: | 3 months   |

## 5 ORTHOGRAPHIC PROJECTIONS

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Orthographic projections provide views of the instrument from three different angles. The TOP view is used for showing instrument *width*. The FRONT view is used for showing instrument *height*. The SIDE view is used for showing instrument *depth*. Width, height, and depth dimensions are used to establish the instrument's *envelope* which is useful for overall sizing and placement concerns.

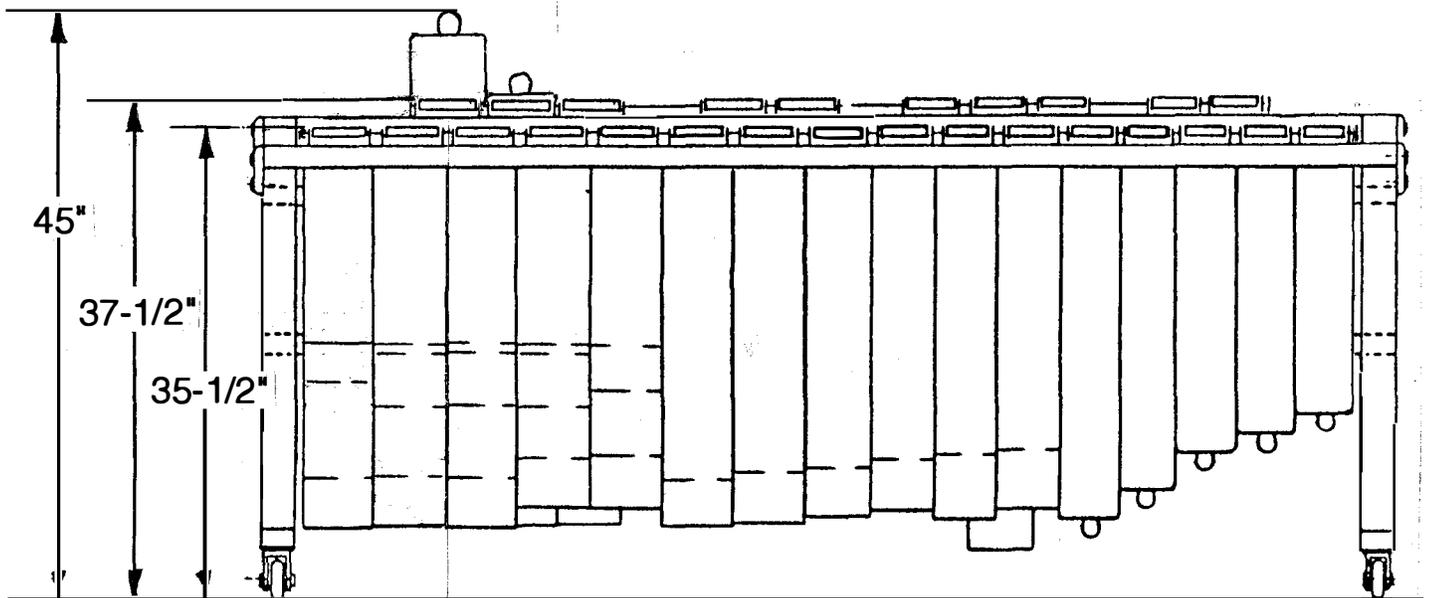
## 5 ORTHOGRAPHIC PROJECTIONS (continued)



TOP VIEW (showing width)

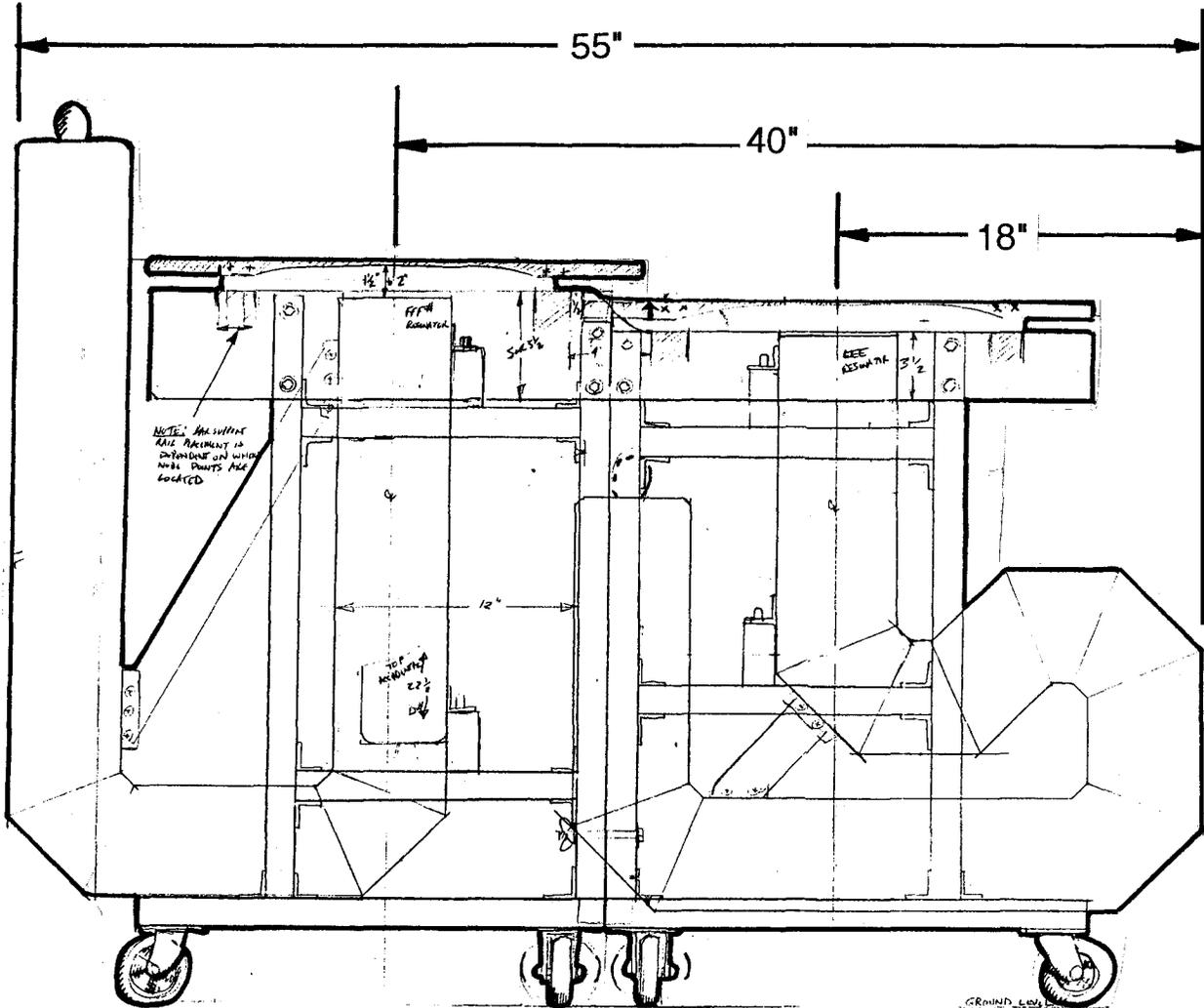
## 5 ORTHOGRAPHIC PROJECTIONS (continued)

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FRONT VIEW (showing height)

## 5 ORTHOGRAPHIC PROJECTIONS (continued)



SIDE VIEWS (showing depth)

## 6 BAR DATA

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### Physical Data

Material: African Padouk, straight grain, quarter-sawn  
 Material Thickness: 7/8"  
 Bar Finish: Varithane (high gloss)

### Bar Dimensions

| NO.   | PITCH<br>(Note) | FREQUENCY<br>(Hertz) | LENGTH<br>(Inches) | WIDTH<br>(Inches) |
|-------|-----------------|----------------------|--------------------|-------------------|
| (1)   | E1              | 41.20                | 25-1/2             | 4-1/4             |
| (2)   | F1 -            | 43.65                | 25-1/8             | 4-3/16            |
| (3)   | F#1 -           | 46.25                | 24-3/4             | 4-1/8             |
| (4)   | G1 -            | 48.99                | 24-3/8             | 4-1/16            |
| (5)   | G#1 -           | 51.91                | 24                 | 4                 |
| (6)   | A -             | 55.00                | 23-5/8             | 3-15/16           |
| (7)   | A#1 -           | 58.27                | 23-1/4             | 3-7/8             |
| (8)   | B1 -            | 61.74                | 22-7/8             | 3-13/16           |
| (9)   | C2 -            | 65.41                | 22-1/2             | 3-3/4             |
| (10)  | C#2 -           | 69.29                | 22-1/8             | 3-11/16           |
| (11)  | D2 -            | 73.42                | 21-3/4             | 3-5/8             |
| (12)  | D#2 -           | 77.78                | 21-3/8             | 3-9/16            |
| (13)  | E2 -            | 82.41                | 21                 | 3-1/2             |
| (14)  | F2 -            | 87.31                | 20-5/8             | 3-7/16            |
| (15)  | F#2 -           | 92.49                | 20-1/4             | 3-3/8             |
| (16)  | G2 -            | 97.99                | 19-7/8             | 3-5/16            |
| (17)  | G#2 -           | 103.83               | 19-1/2             | 3-1/4             |
| (18)) | A2 -            | 110.00               | 19-1/8             | 3-3/16            |
| (19)  | A#2 -           | 116.54               | 18-3/4             | 3-1/8             |
| (20)  | B2 -            | 123.47               | 18-3/8             | 3-1/16            |
| (21)  | C3 -            | 130.81               | 18                 | 3                 |
| (22)  | C#3 -           | 138.59               | 17-5/8             | 2-15/16           |
| (23)  | D3 -            | 146.83               | 17-1/4             | 2-7/8             |
| (24)  | D#3 -           | 155.56               | 16-7/8             | 2-13/16           |
| (25)  | E3 -            | 164.81               | 16-1/2             | 2-3/4             |
| (26)  | F3 -            | 174.61               | 16-1/8             | 2-11/16           |

## 6 BAR DATA (continued)

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### Tuning Accuracy:

|                                 |             |
|---------------------------------|-------------|
| 1st Harmonic (1:1), fundamental | +2 -0 cents |
| 2nd Harmonic (1:4)              | +2 -0 cents |
| 3rd Harmonic (1:10)             | +5 -0 cents |

### Mounting Holes (per bar)

|                |  |
|----------------|--|
| Hole Quantity: | 2  |
| Hole Location: | 7/16" from the playing surface, 7/16" from the underside surface, with holes drilled at the bar's fundamental node points. |
| Hole Size:     | 3/16" diameter with countersink (for ease of cord insertion).  |

### Pitch Identification

|                   |   |
|-------------------|---|
| Type:             | Steel stamp imprinted lettering                         |
| Lettering Height: | 5/16"   |
| Location:         | Front of bar facing performer, 1/2" from end, centered. |

## 7 RESONATOR DATA

---

### General Data

Type: Quarter-wavelength ( $1/4\lambda$ ) column, with adjustable tuning stopper at one end, fully opened at end directly beneath bar.

Material: White pine, 3/4" thickness

Resonator finish: Varithane clear, high gloss

### Resonator Dimensions

| NO.  | PITCH<br>(Note) | FREQUENCY<br>(Hertz) | UNMITERED<br>COLUMN<br>LENGTH<br>(Inches) | INSIDE<br>CROSS<br>SECTION<br>(Inches) | OUTSIDE<br>CROSS<br>SECTION<br>(Inches) | MITERING<br>REQUIRED |
|------|-----------------|----------------------|---|--|---|----------------------|
| (1)  | E1              | 41.20                | 84  | 4-1/4                                  | 5-3/4                                   | YES                  |
| (2)  | F1 -            | 43.65                | 80  | 4-3/16                                 | 5-11/16                                 | YES                  |
| (3)  | F#1 -           | 46.25                | 77  | 4-1/8                                  | 5-5/8                                   | YES                  |
| (4)  | G1 -            | 48.99                | 72-5/8                                    | 4-1/16                                 | 5-9/16                                  | YES                  |
| (5)  | G#1 -           | 51.91                | 68  | 4                                      | 5-1/2                                   | YES                  |
| (6)  | A -             | 55.00                | 63-5/8                                    | 3-15/16                                | 5-7/16                                  | YES                  |
| (7)  | A#1 -           | 58.27                | 61  | 3-7/8                                  | 5-3/8                                   | YES                  |
| (8)  | B1 -            | 61.74                | 56-1/2                                    | 3-13/16                                | 5-5/16                                  | YES                  |
| (9)  | C2 -            | 65.41                | 54  | 3-3/4                                  | 5-1/4                                   | YES                  |
| (10) | C#2 -           | 69.29                | 50-1/2                                    | 3-11/16                                | 5-3/16                                  | YES                  |
| (11) | D2 -            | 73.42                | 47  | 3-5/8                                  | 5-1/8                                   | YES                  |
| (12) | D#2 -           | 77.78                | 44-1/2                                    | 3-9/16                                 | 5-1/16                                  | YES                  |
| (13) | E2 -            | 82.41                | 42  | 3-1/2                                  | 5                                       | YES                  |
| (14) | F2 -            | 87.31                | 39-3/4                                    | 3-7/16                                 | 4-15/16                                 | YES                  |
| (15) | F#2 -           | 92.49                | 38  | 3-3/8                                  | 4-7/8                                   | YES                  |
| (16) | G2 -            | 97.99                | 135-1/2                                   | 3-5/16                                 | 4-13/16                                 | YES                  |
| (17) | G#2 -           | 103.83               | 33-3/4                                    | 3-1/4                                  | 4-3/4                                   | YES                  |
| (18) | A2 -            | 110.00               | 32  | 3-3/16                                 | 4-11/16                                 | YES                  |
| (19) | A#2 -           | 116.54               | 30-1/4                                    | 3-1/8                                  | 4-5/8                                   | NO                   |
| (20) | B2 -            | 123.47               | 28-1/2                                    | 3-1/16                                 | 4-9/16                                  | NO                   |
| (21) | C3 -            | 130.81               | 26-1/2                                    | 3                                      | 4-1/2                                   | NO                   |
| (22) | C#3 -           | 138.59               | 24-3/4                                    | 2-15/16                                | 4-7/16                                  | NO                   |
| (23) | D3 -            | 146.83               | 23-1/4                                    | 2-7/8                                  | 4-3/8                                   | NO                   |
| (24) | D#3 -           | 155.56               | 22-1/2                                    | 2-13/16                                | 4-5/16                                  | NO                   |
| (25) | E3 -            | 164.81               | 21-1/2                                    | 2-3/4                                  | 4-1/4                                   | NO                   |
| (26) | F3 -            | 174.61               | 19-3/4                                    | 2-11/16                                | 4-3/16                                  | NO                   |

## 7 RESONATOR DATA (continued)

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### Tuning Accuracy

Fundamental: +10 -0 cents

### Stopper Control

Containment: Stoppers are air-tight fit, and held in place with felt gasketing.

### Resonator Support

Ridigness\* Long, mitered resonators have intra-resonator bracing to relieve stress on miter joints.

## 8 MISCELLANEOUS DATA

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### Bar Containment

- Support Blocks: Situated on bar support rails, properly spaced so bar center aligns over acoustic center of resonator.
- Spacing Control: Front-Rail Punching (felt washers used on pianos), medium (Qty 4 per bar).
- Suspension: Cord, 5/32" nylon (soft), fine weave
- Taughtness Control: Springs, extension coil (Qty 2 per natural and accidental bar groupings)

### Resonator Containment

- Mounting Brackets: Gravity hold on frame support beams using "L" angle extruded aluminum held in place with aluminum doweling.
- Anti-Buzz/Rattle: Felt lining placed between resonator and support beam interfaces.

### Frame Assembly

- Permanent Components: Interfaces attached using extruded aluminum "L" angle brackets, held in place with machine screws.
- Removable Components: Interfaces attached using 5/16" hex bolt/washer/nut combinations.

## 8 MISCELLANEOUS DATA (continued)

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Frame Color: Charcoal Gray, Satin, automotive lacquer  
(1984 Mercedes-Benz)

### Mobility

Casters: 4" diameter, rubber (Qty 4 per half)  
Mounting: 3/4" 12 sheet metal, pan head

## **APPENDICES**

Appendix A - Resonator Data

Appendix B - Design Data and Construction Information

Appendix C - Materials List

Appendix D - Miscellaneous Data

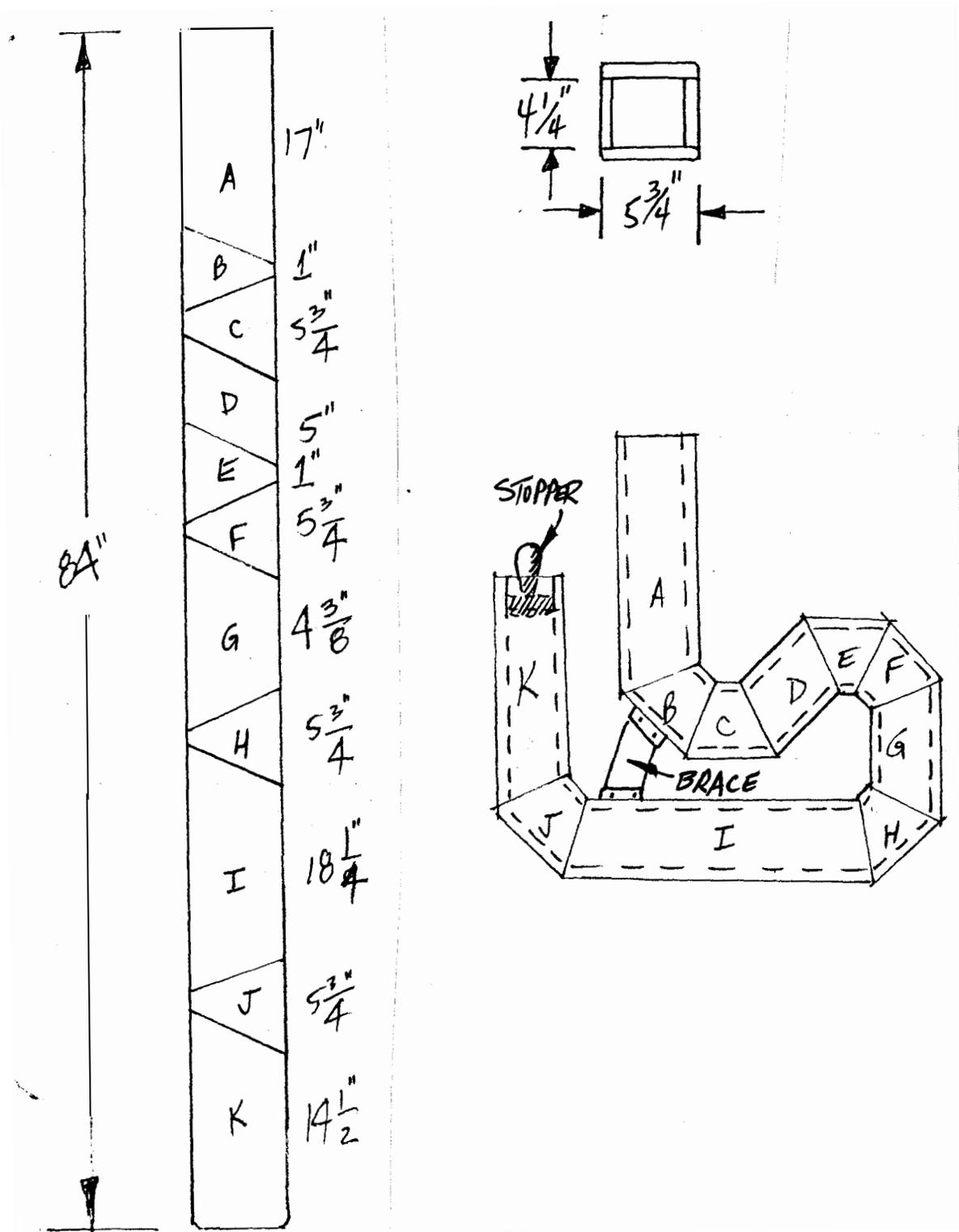
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**APPENDIX A**

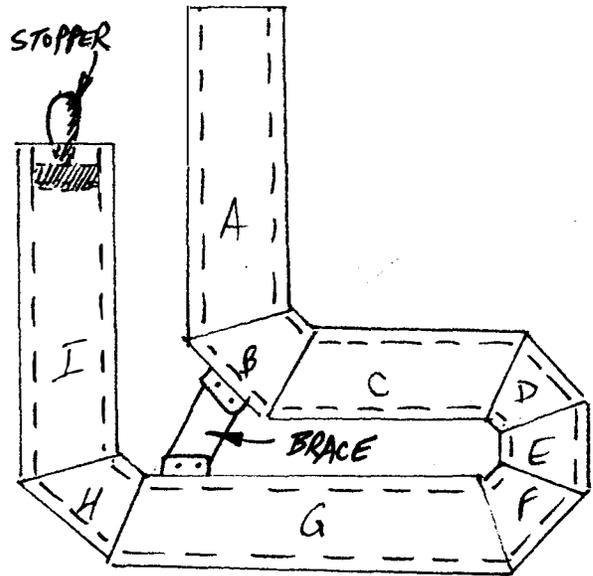
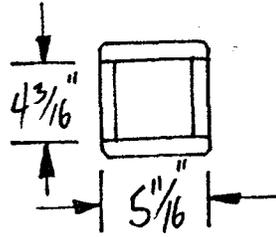
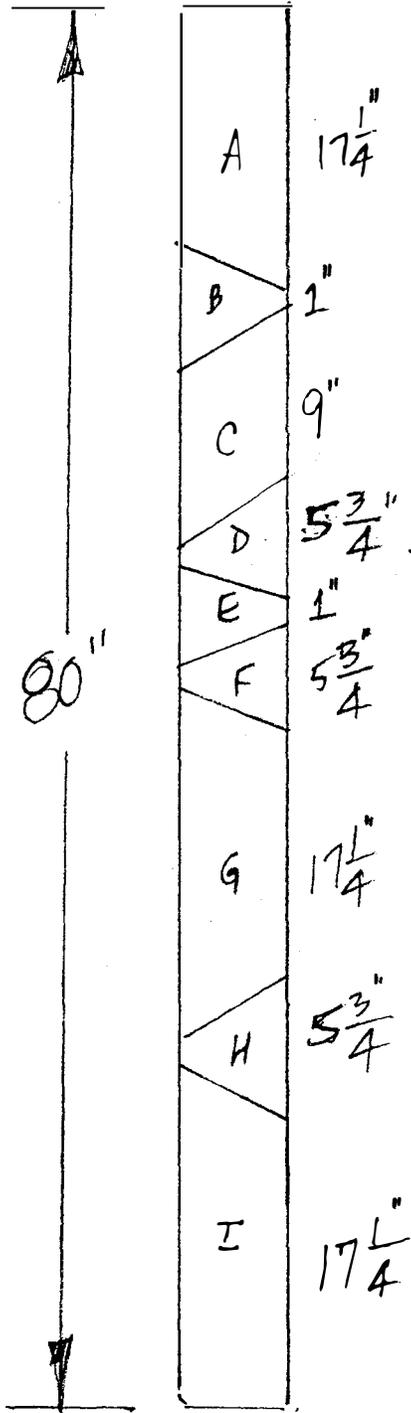
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**Resonator Data**

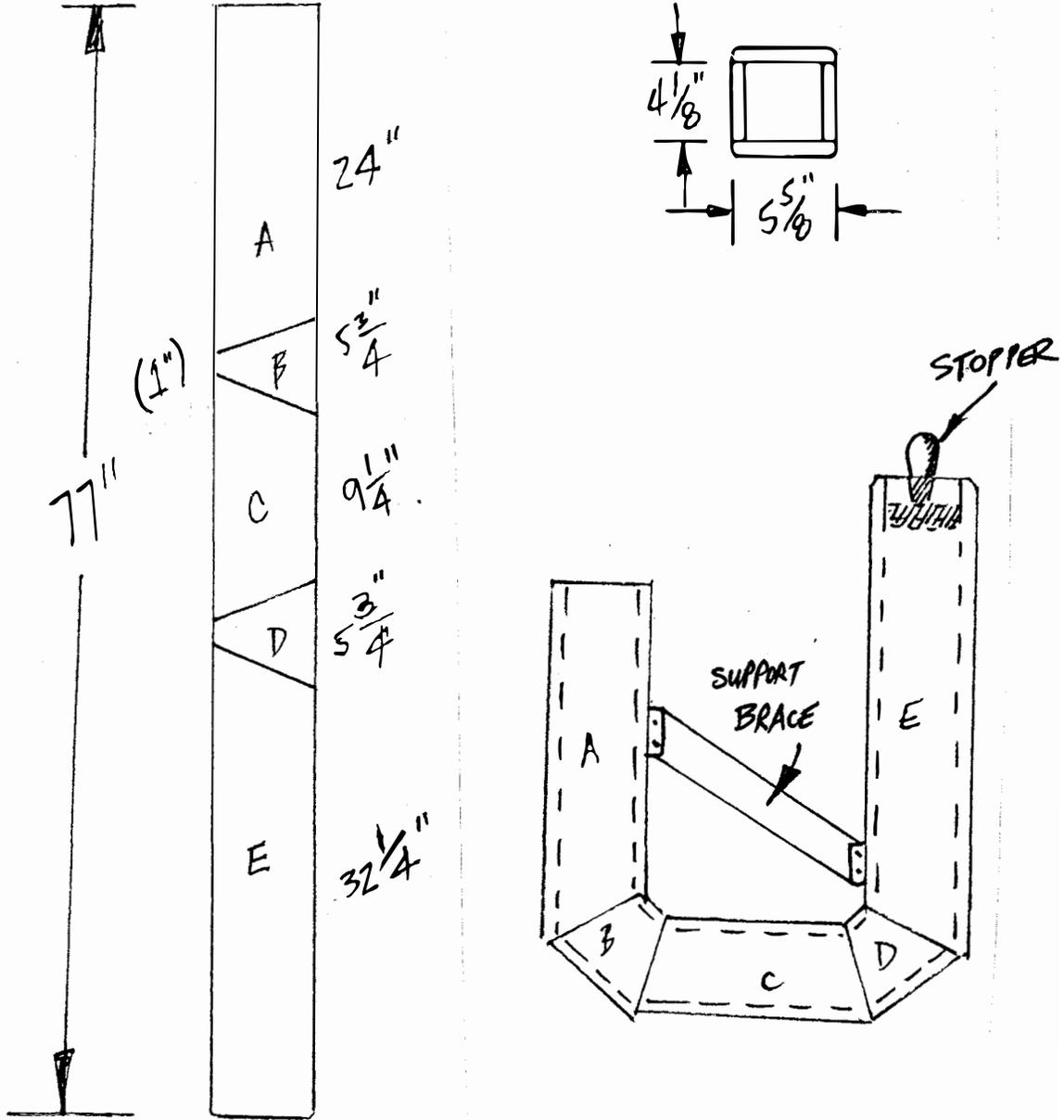
### COLUMN RESONATOR - E1 (41.20Hz)



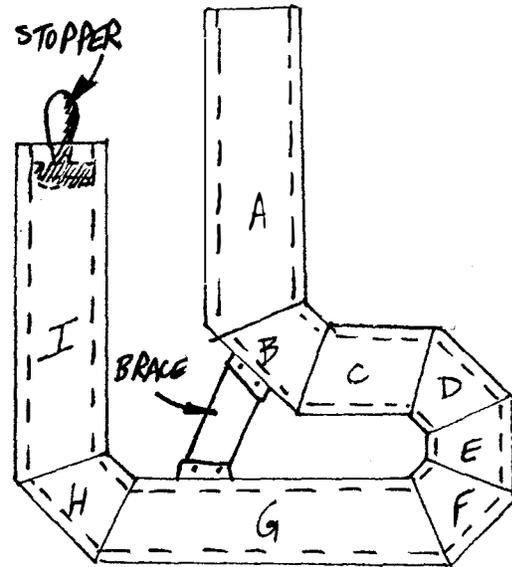
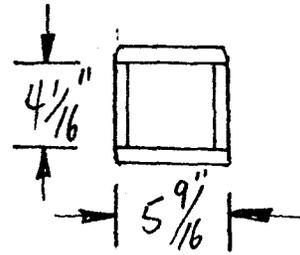
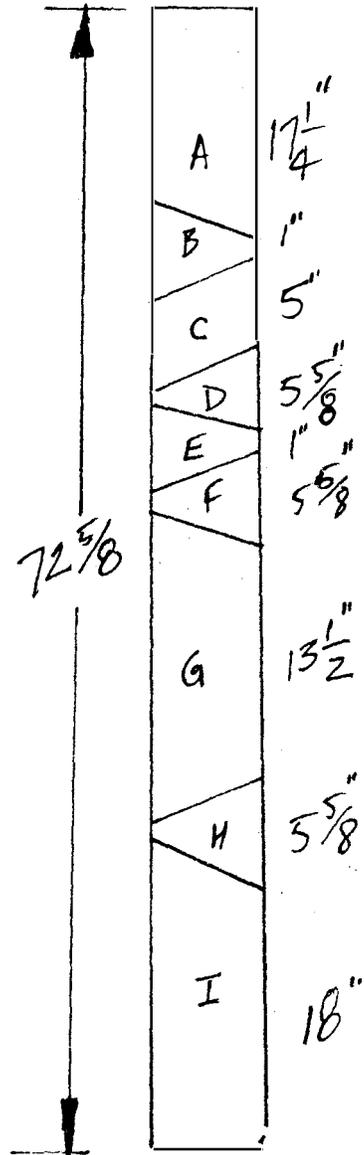
### COLUMN RESONATOR - F1 (43.65)



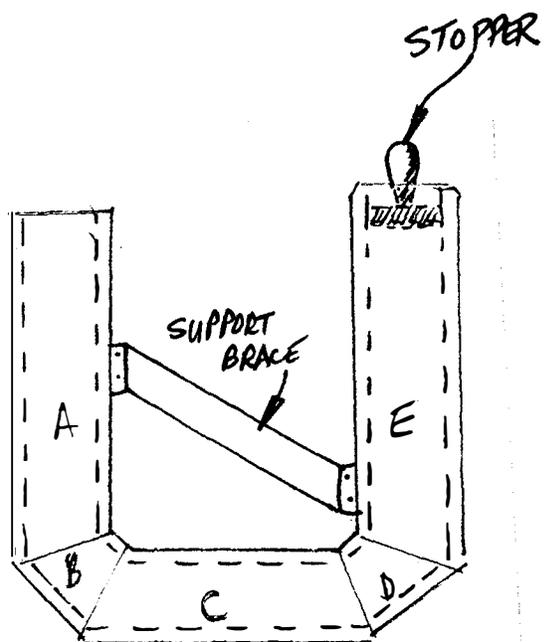
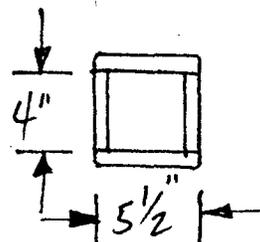
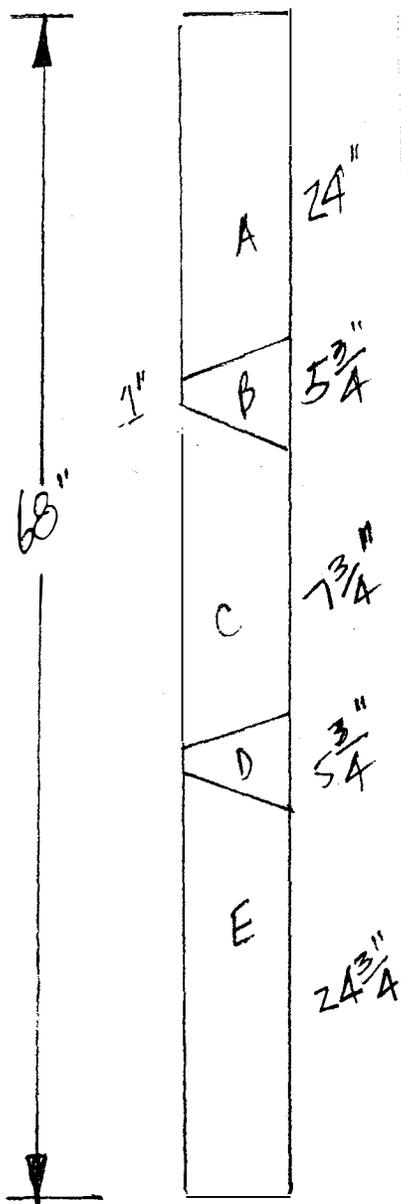
### COLUMN RESONATOR - F#1 (46.25Hz)



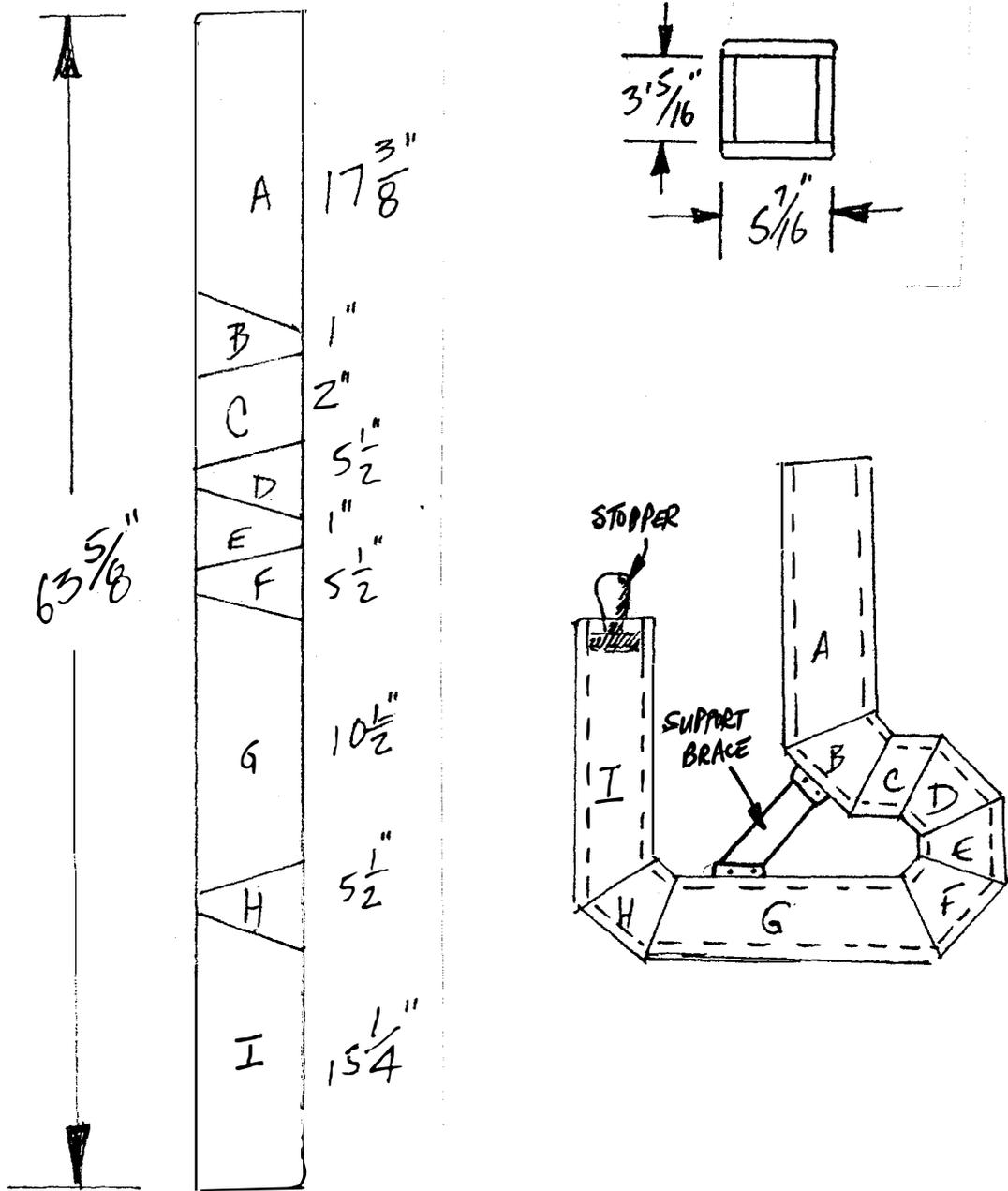
### COLUMN RESONATOR - G1 (48.99Hz)



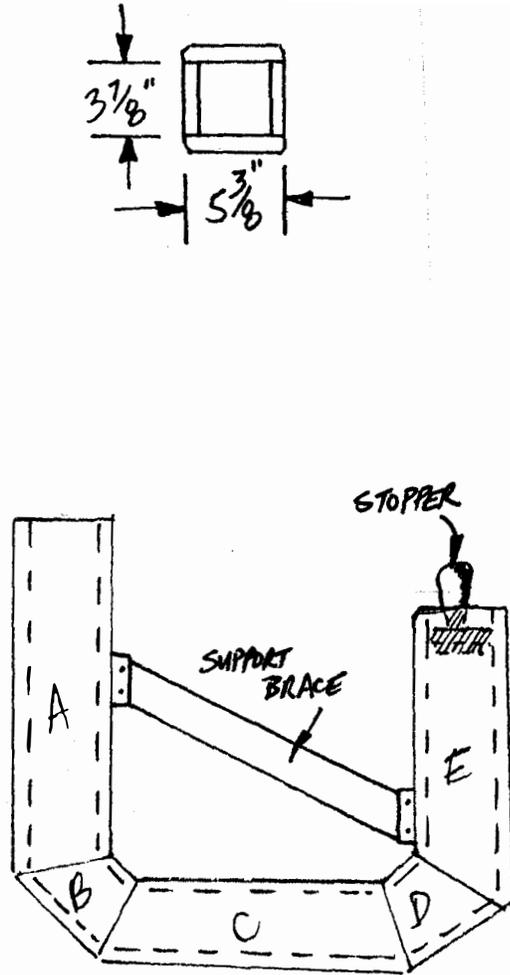
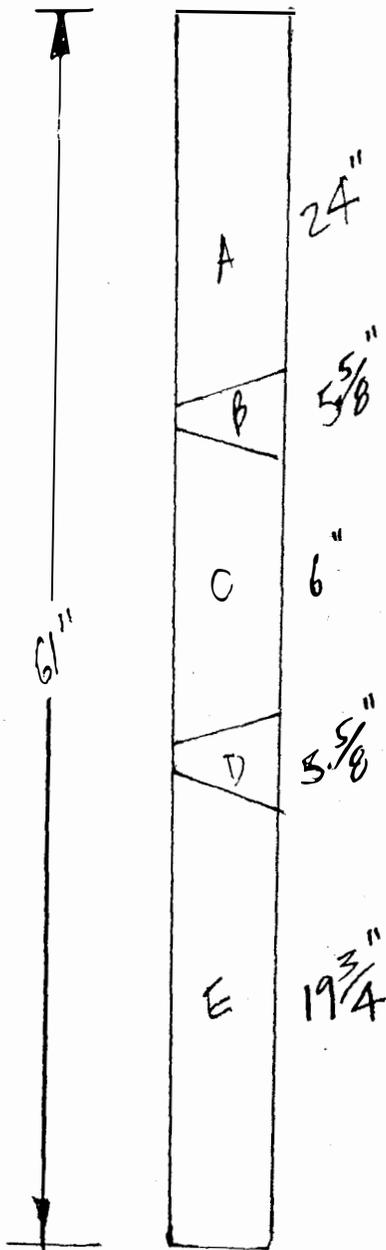
### COLUMN RESONATOR - G#1 (51.91Hz)



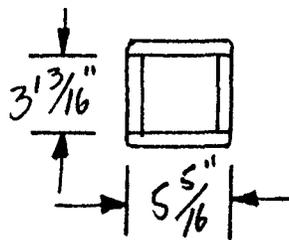
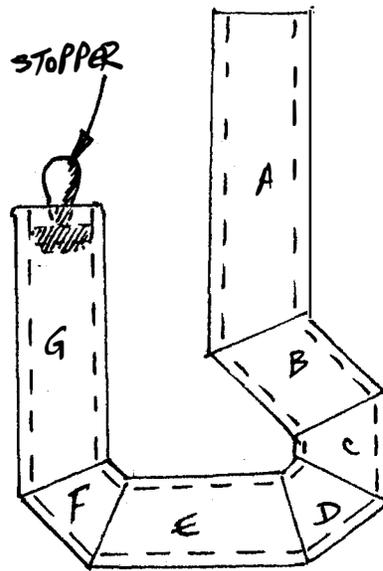
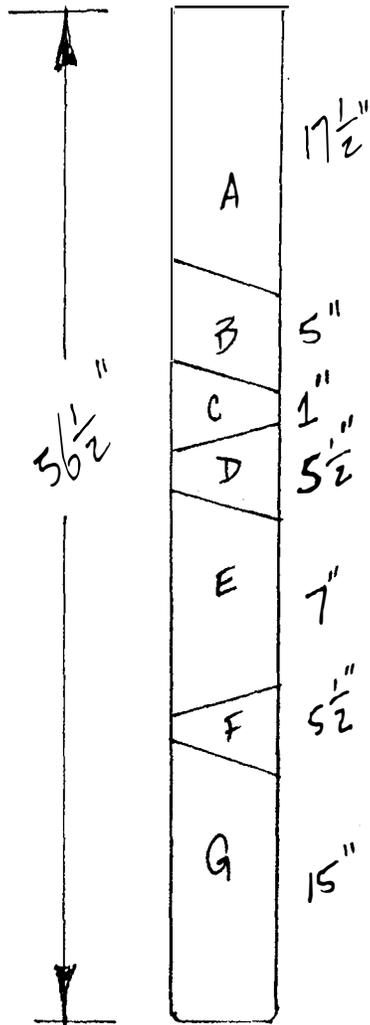
### COLUMN RESONATOR - A1 (55.00Hz)



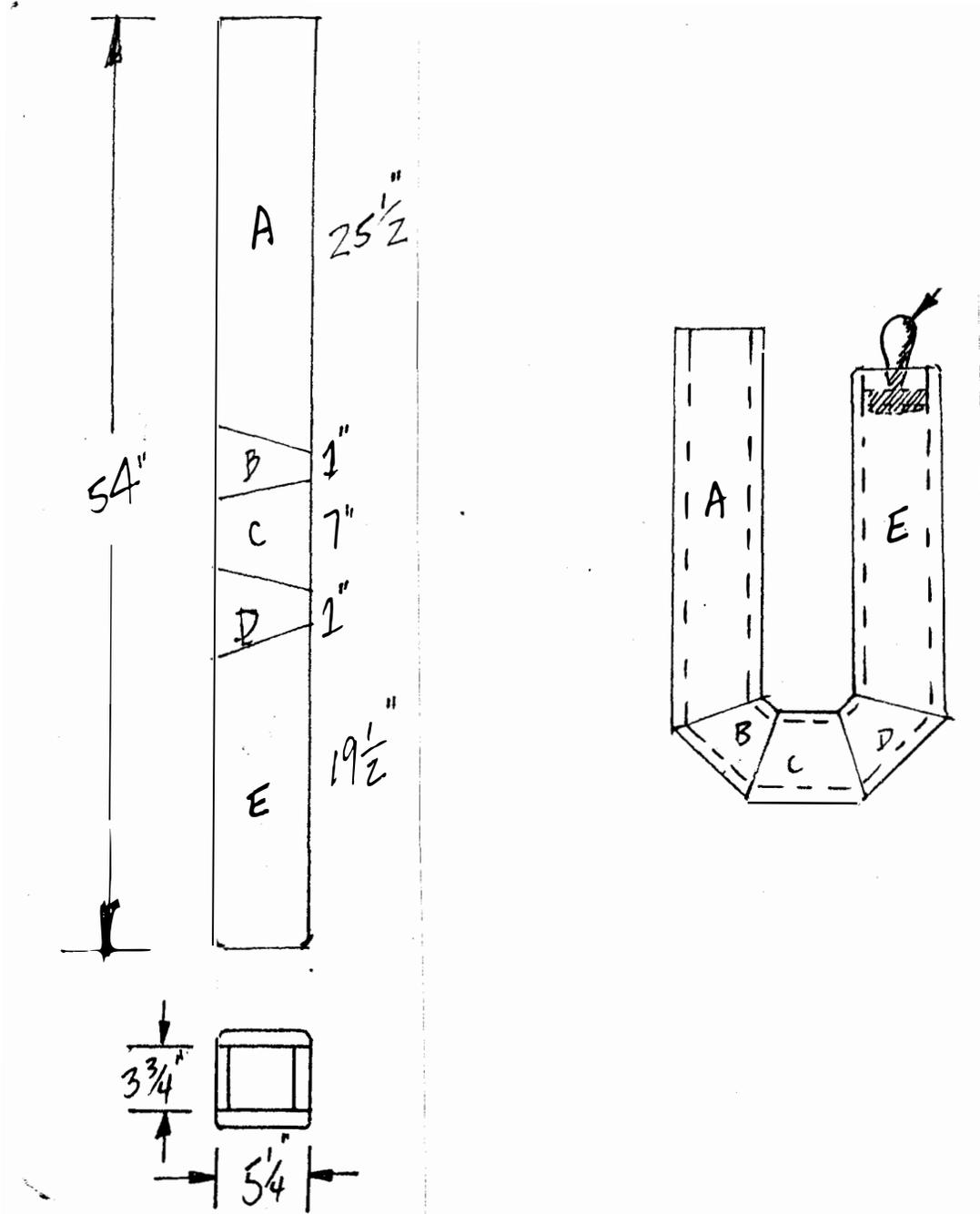
### COLUMN RESONATOR - A#1 (58.27Hz)



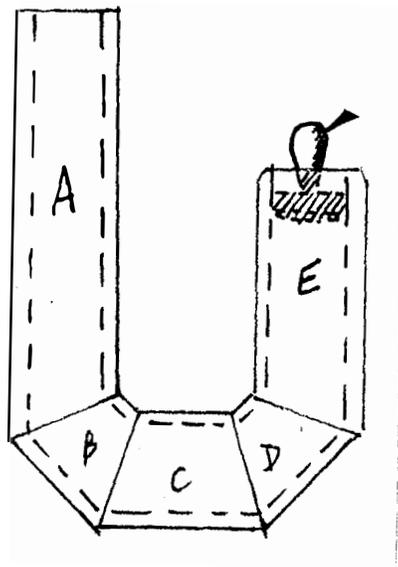
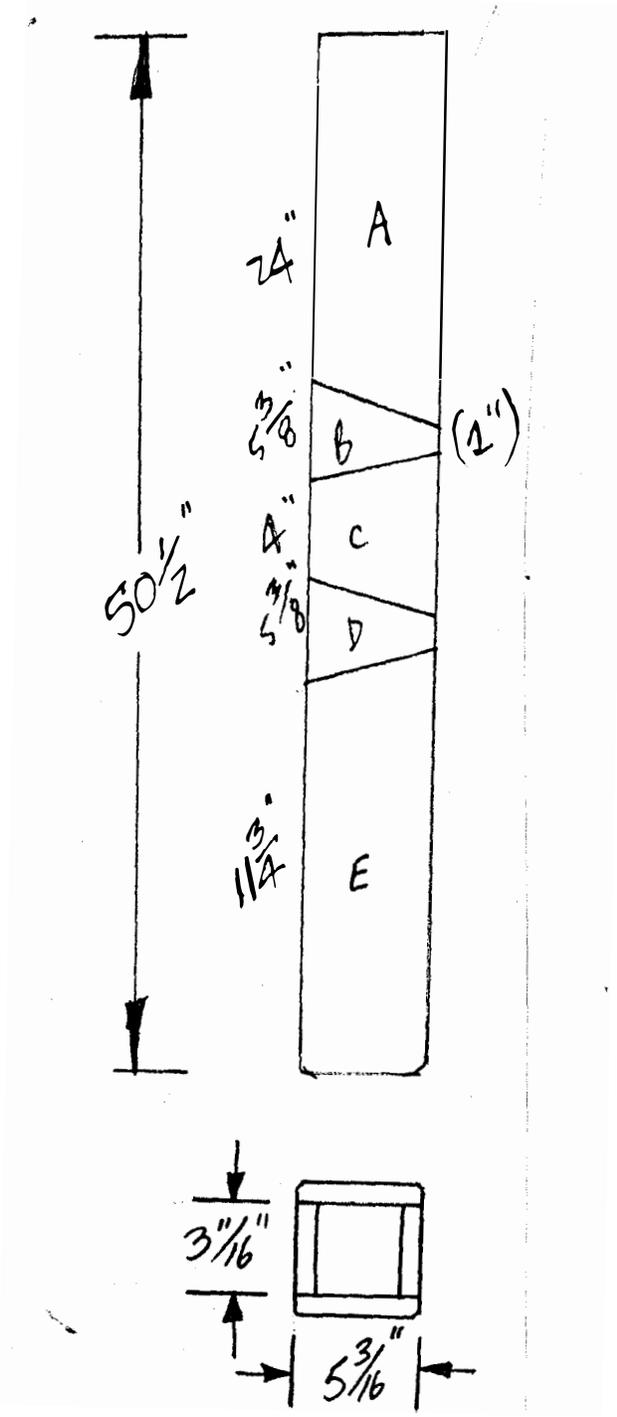
### COLUMN RESONATOR - B1 (61.74Hz)



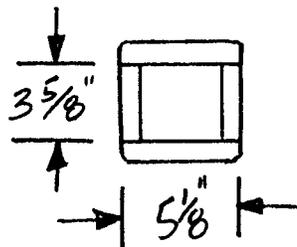
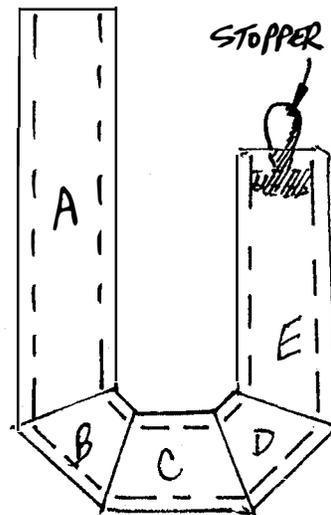
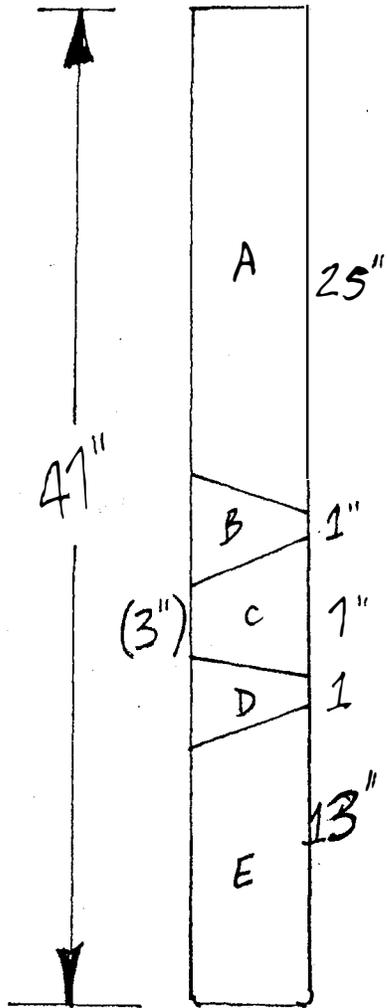
### COLUMN RESONATOR - C2 (65.41Hz)



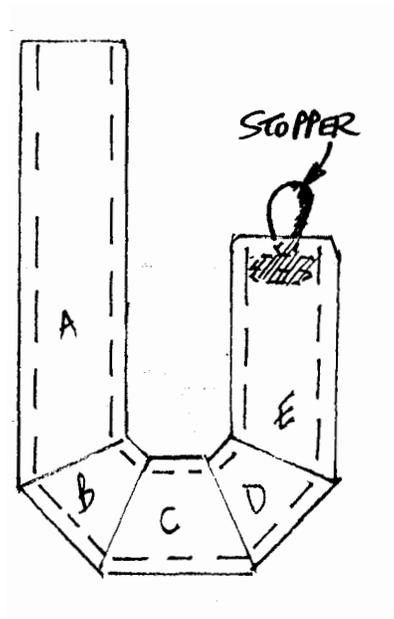
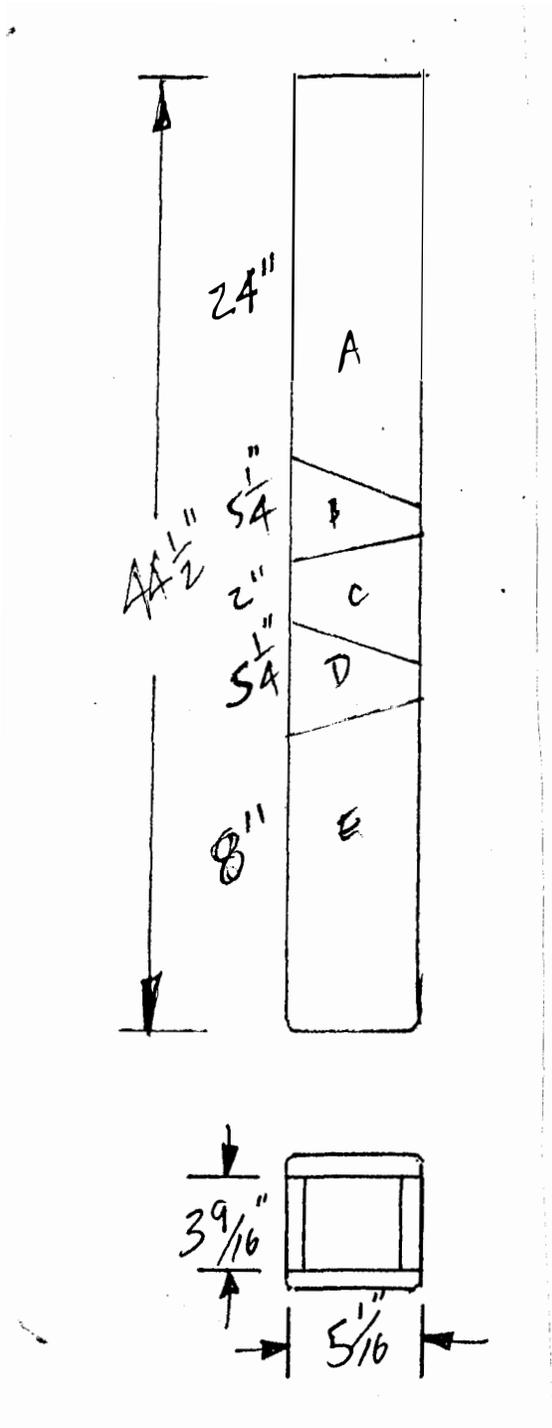
### COLUMN RESONATOR - C#2 (69.29Hz)



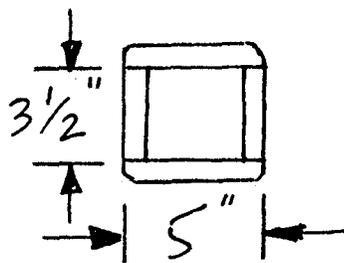
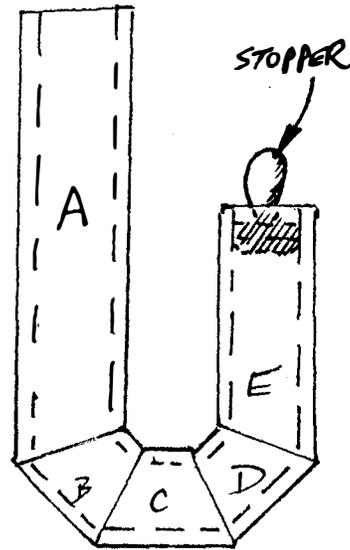
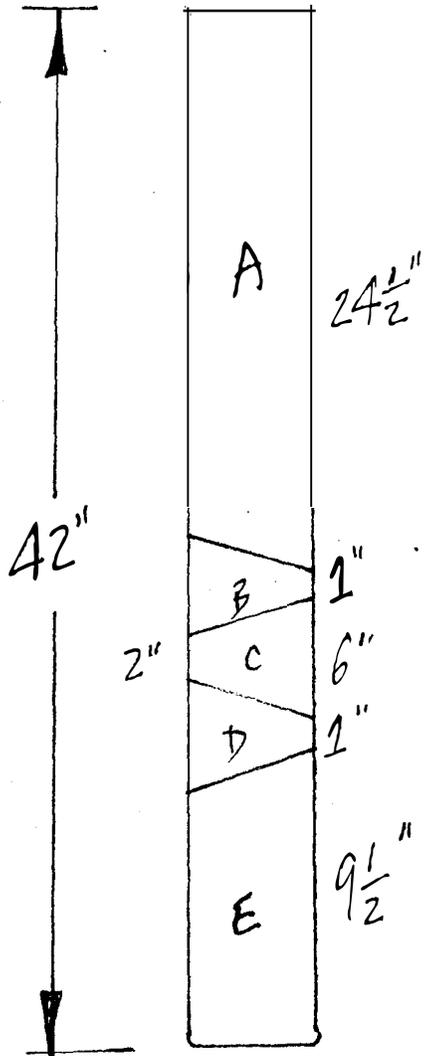
### COLUMN RESONATOR - D2 (73.42Hz)



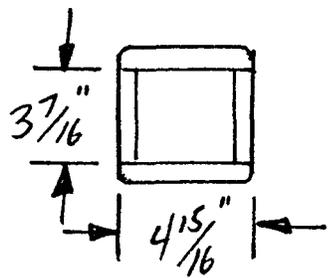
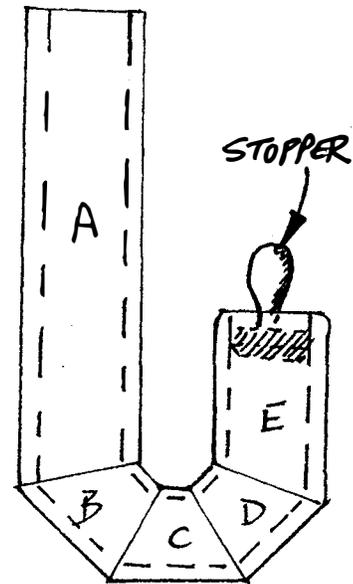
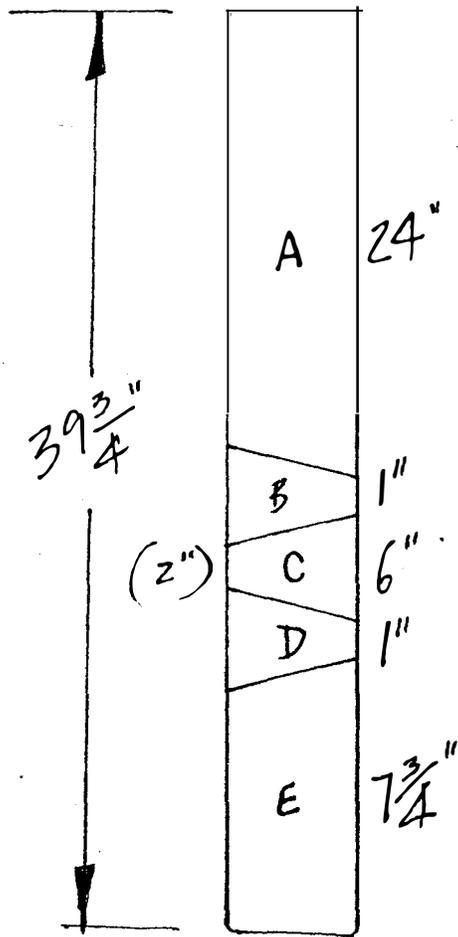
### COLUMN RESONATOR - D#2 (77.78Hz)



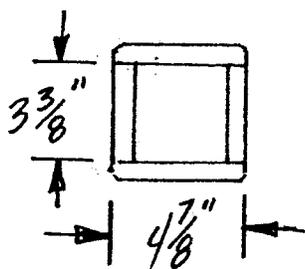
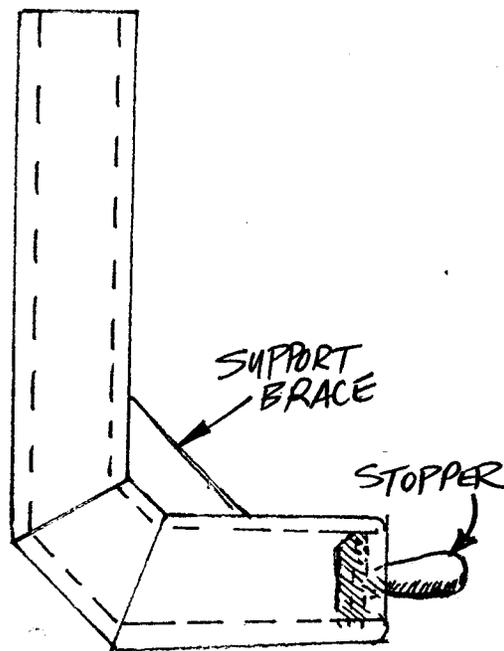
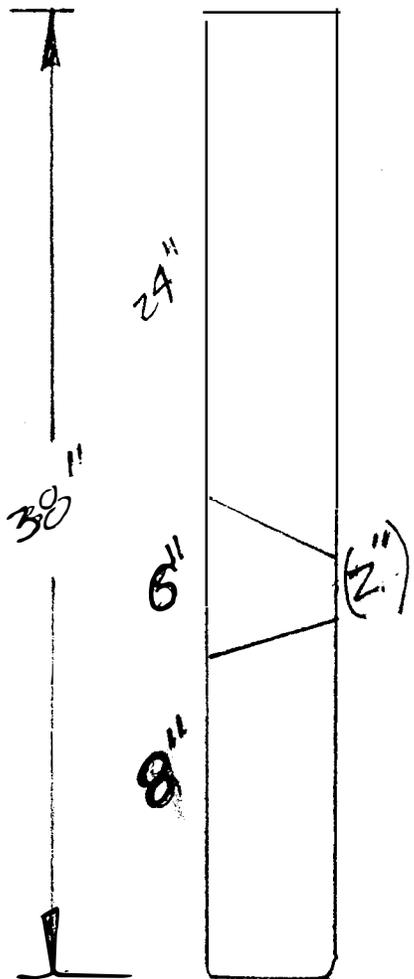
### COLUMN RESONATOR - E2 (82.41Hz)



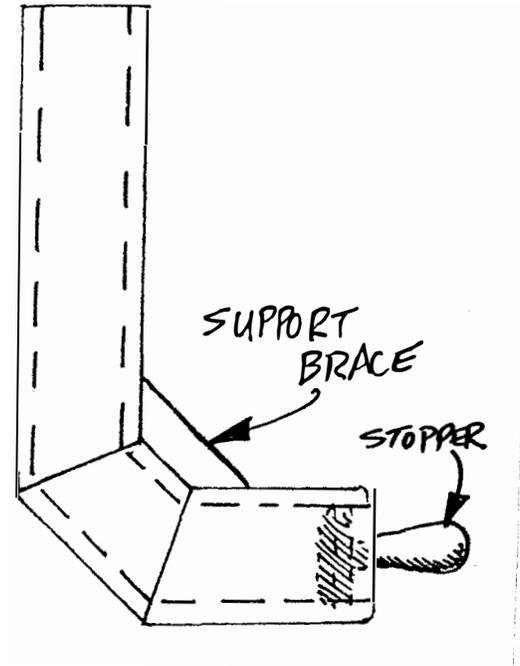
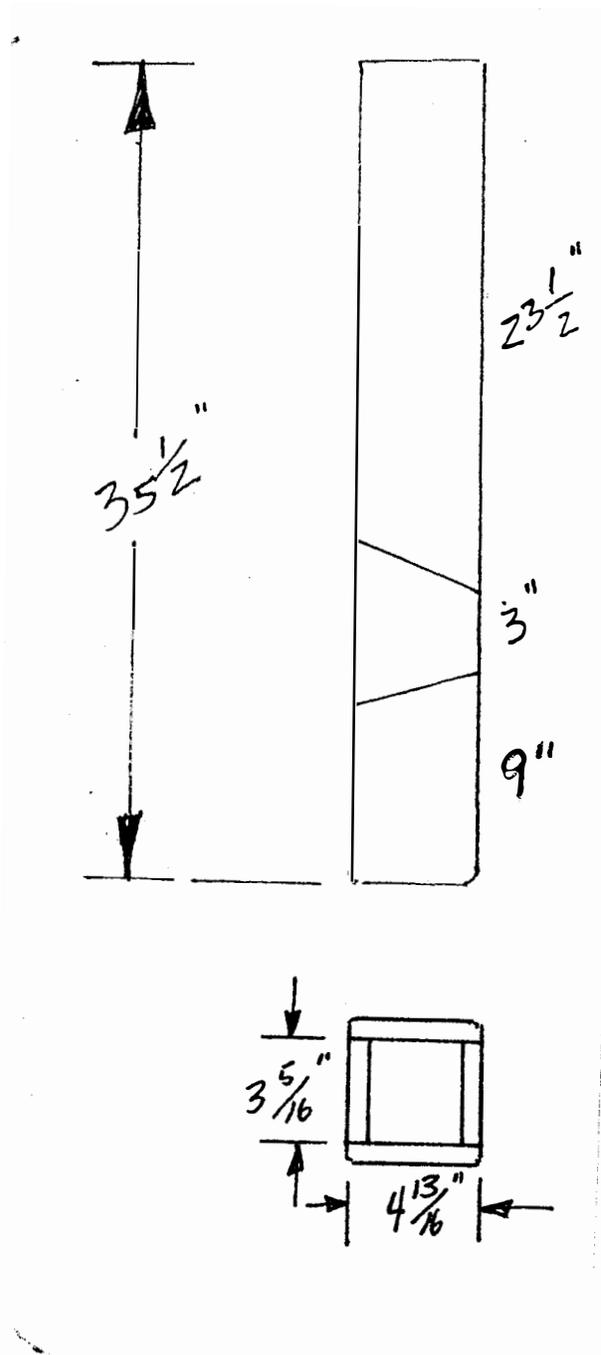
### COLUMN RESONATOR - F2 (87.31Hz)



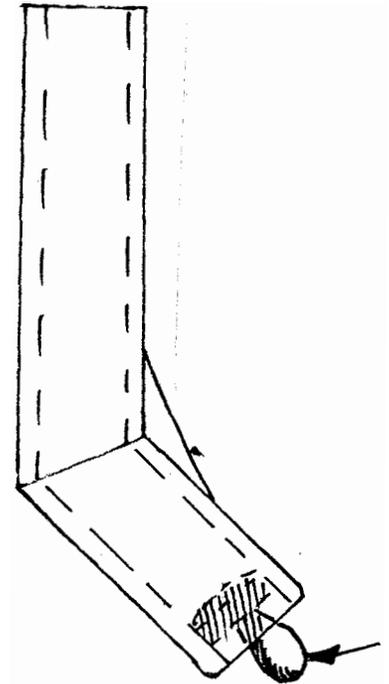
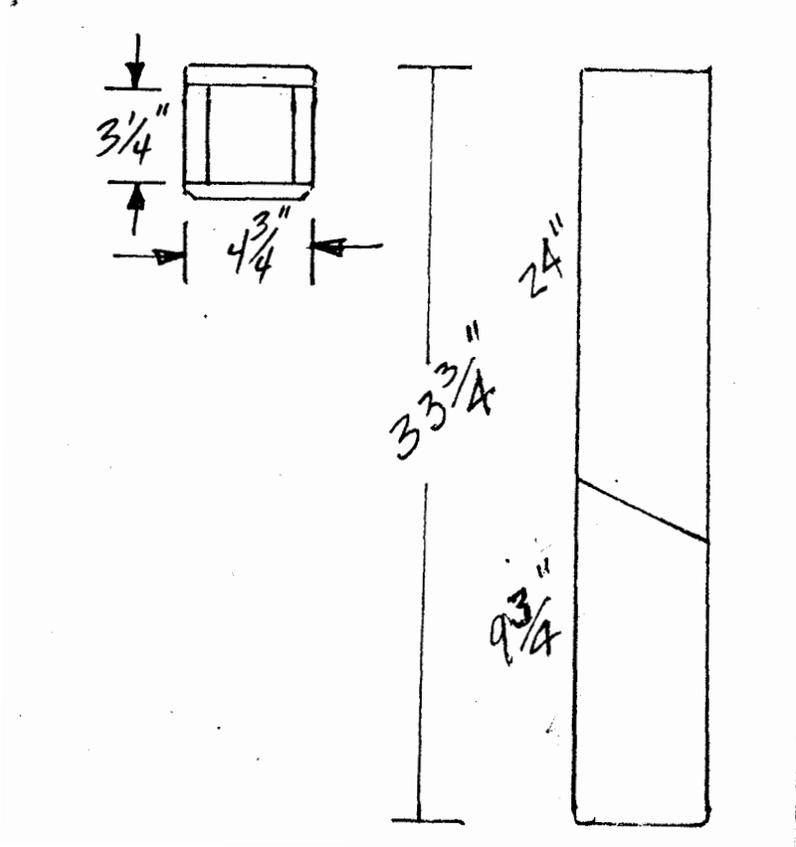
### COLUMN RESONATOR - F#2 (92.49Hz)



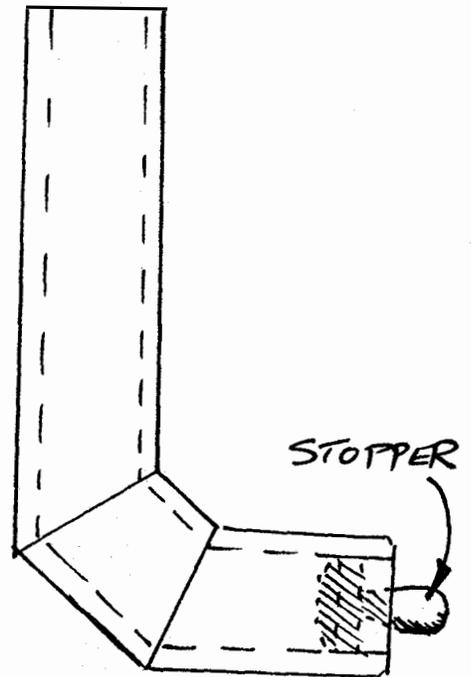
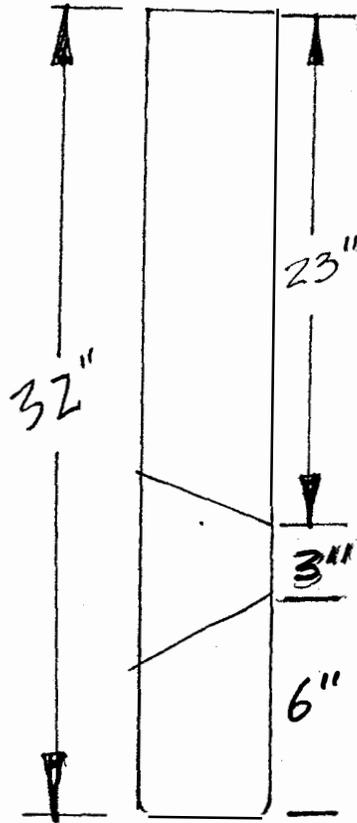
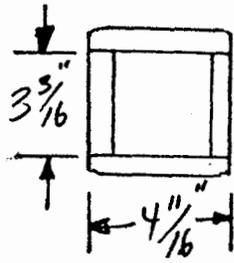
### COLUMN RESONATOR - G2 (97.99Hz)



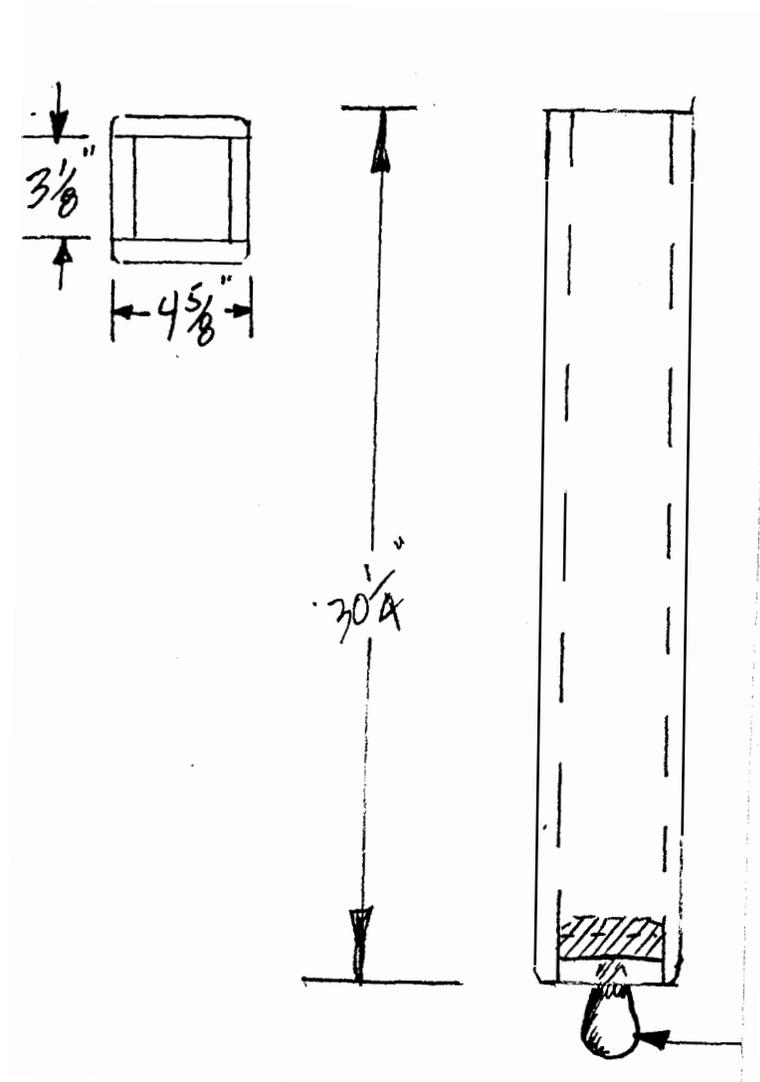
COLUMN RESONATOR - G#2 (103.83Hz)



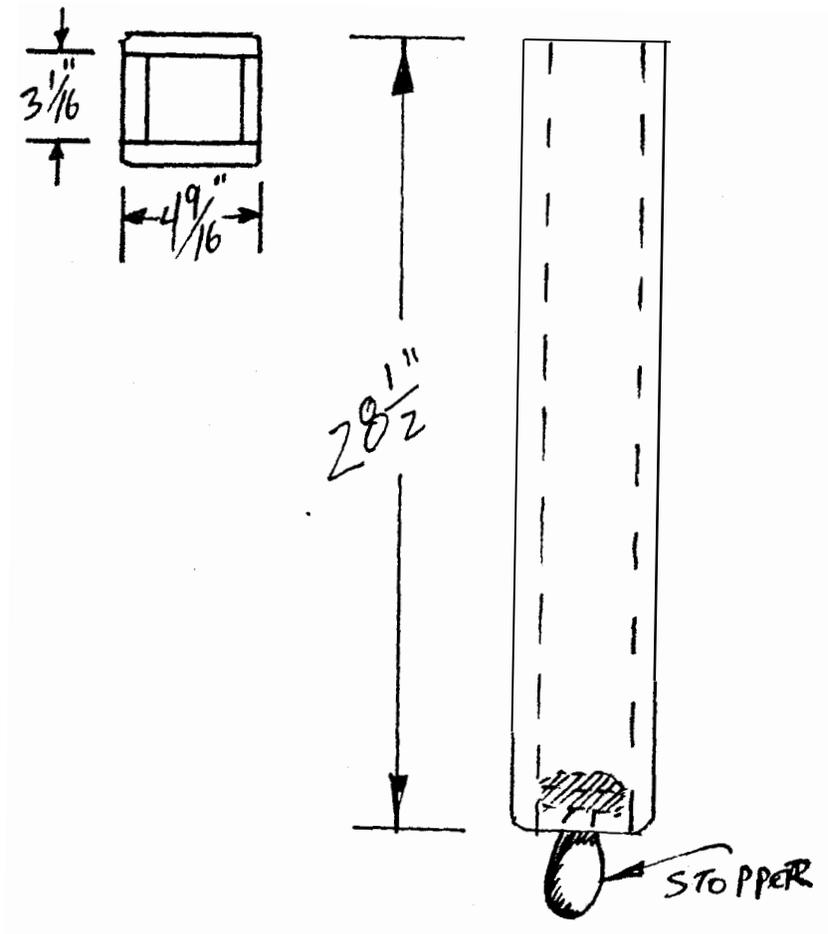
### COLUMN RESONATOR - A2 (110.00Hz)



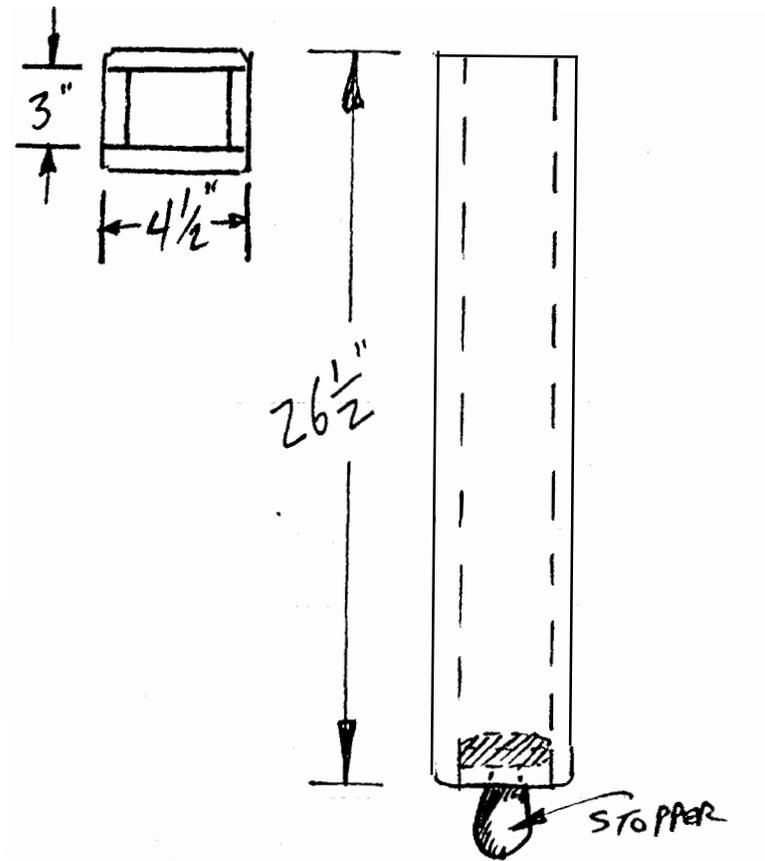
COLUMN RESONATOR - A#2 (116.54Hz)



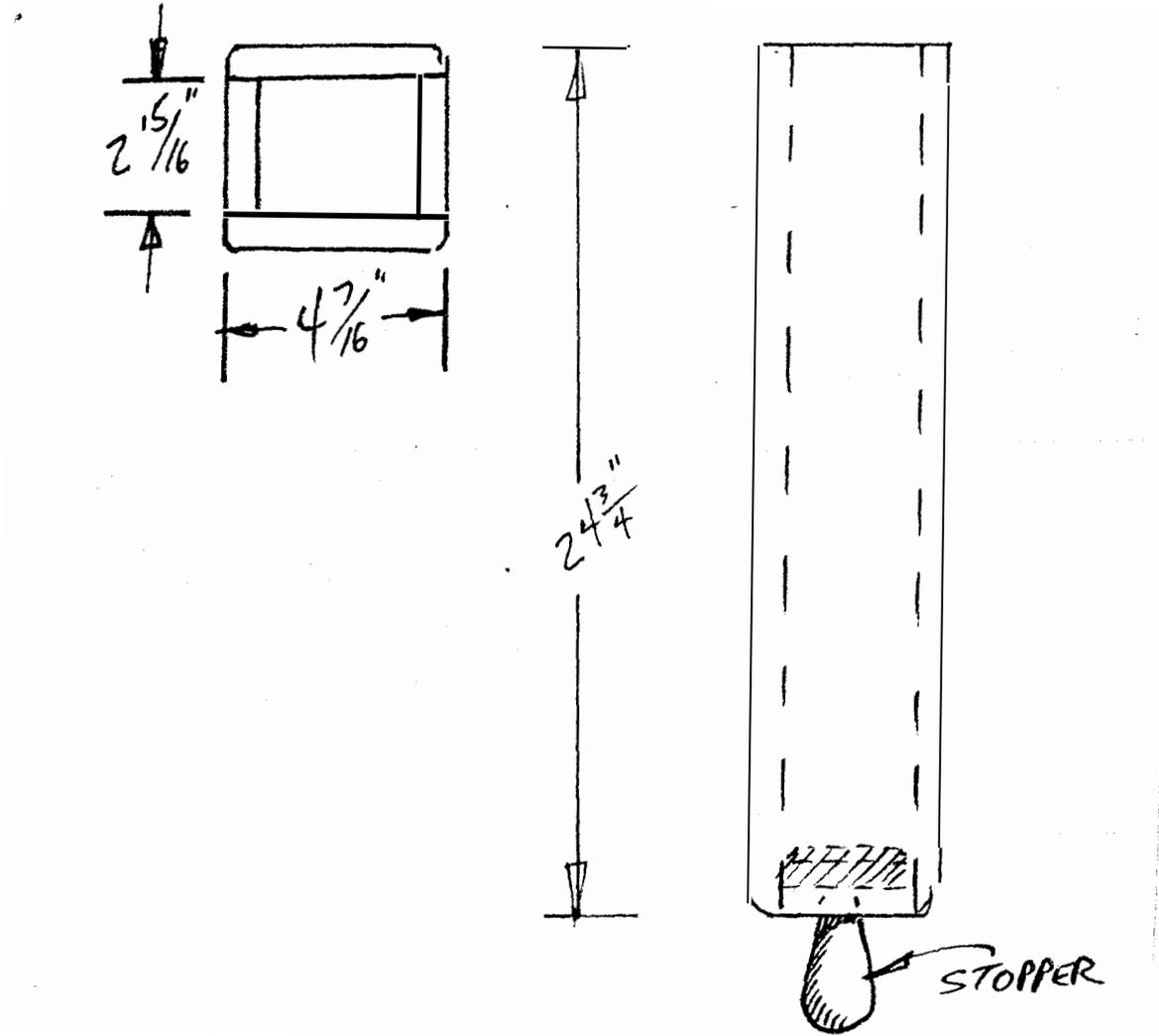
COLUMN RESONATOR - B2 (123.47Hz)



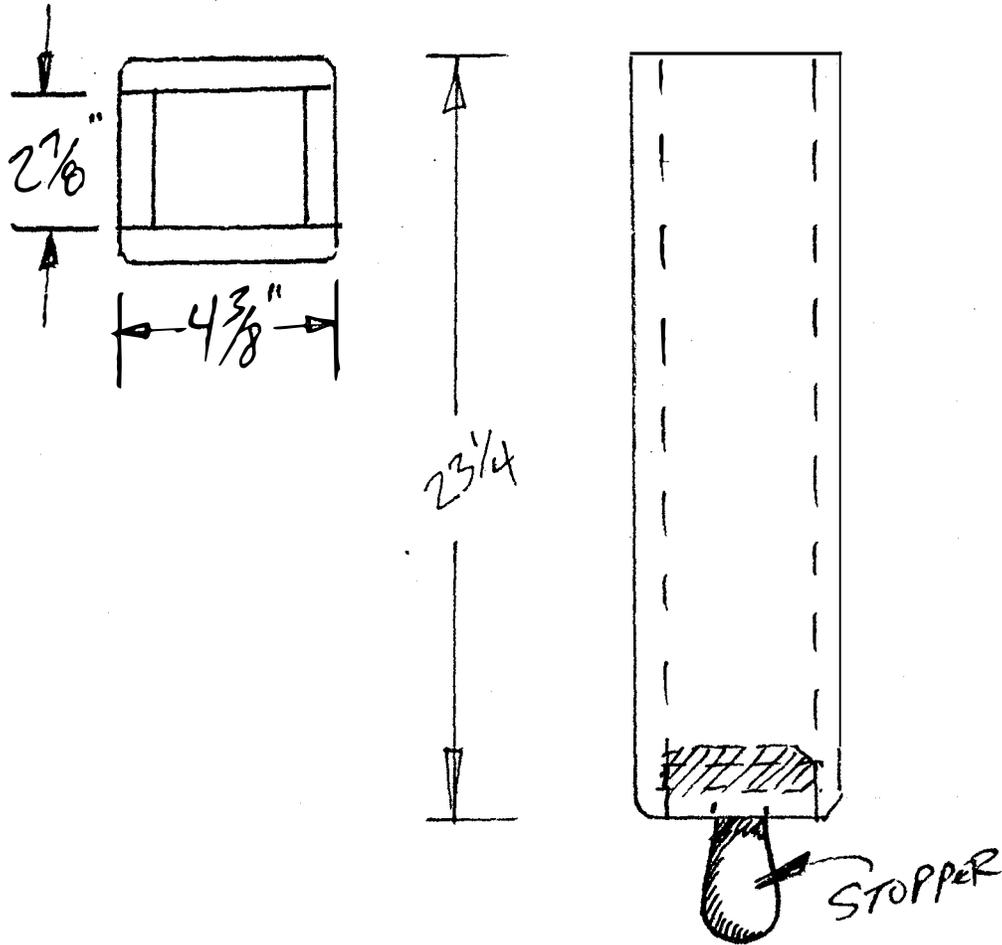
### COLUMN RESONATOR - C3 (130.81Hz)



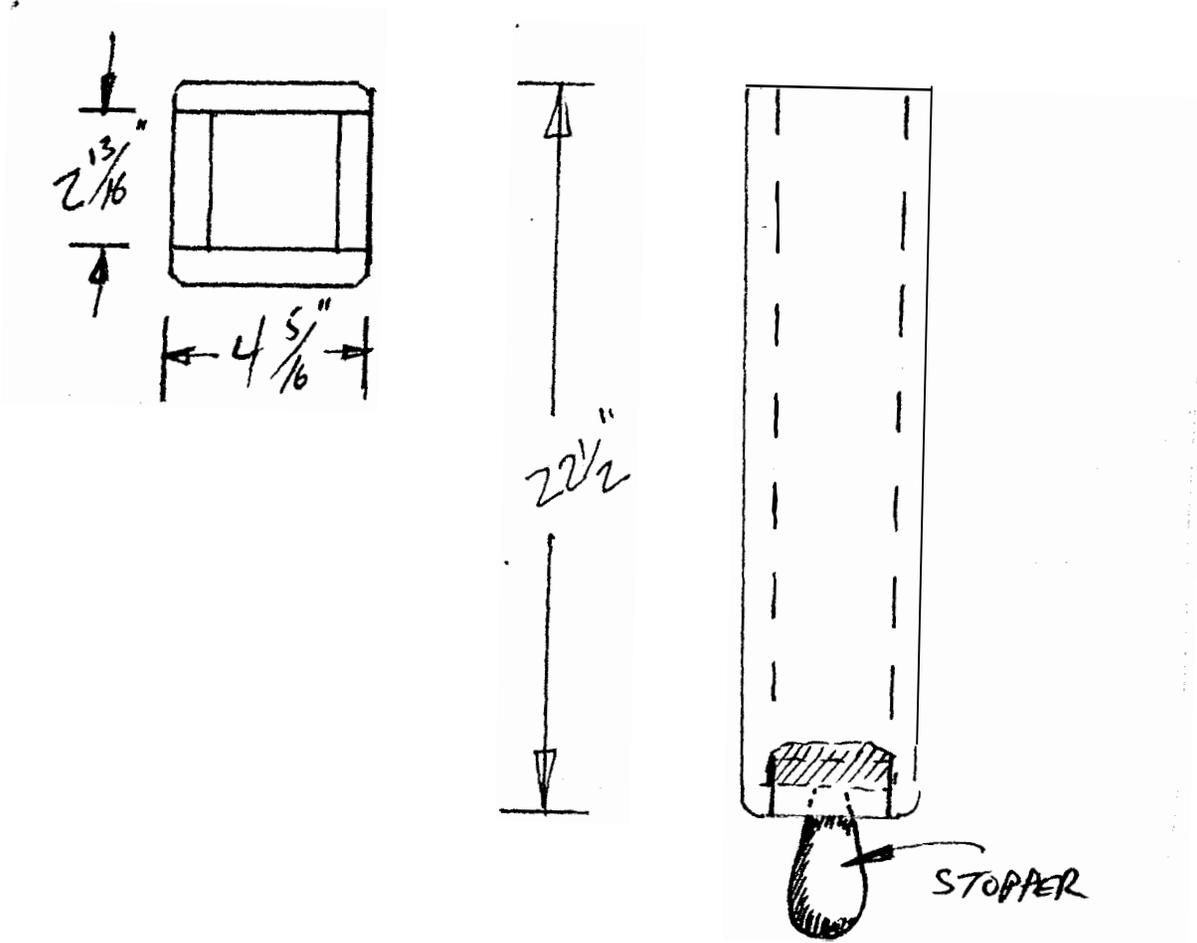
COLUMN RESONATOR - C#3 (138.59Hz)



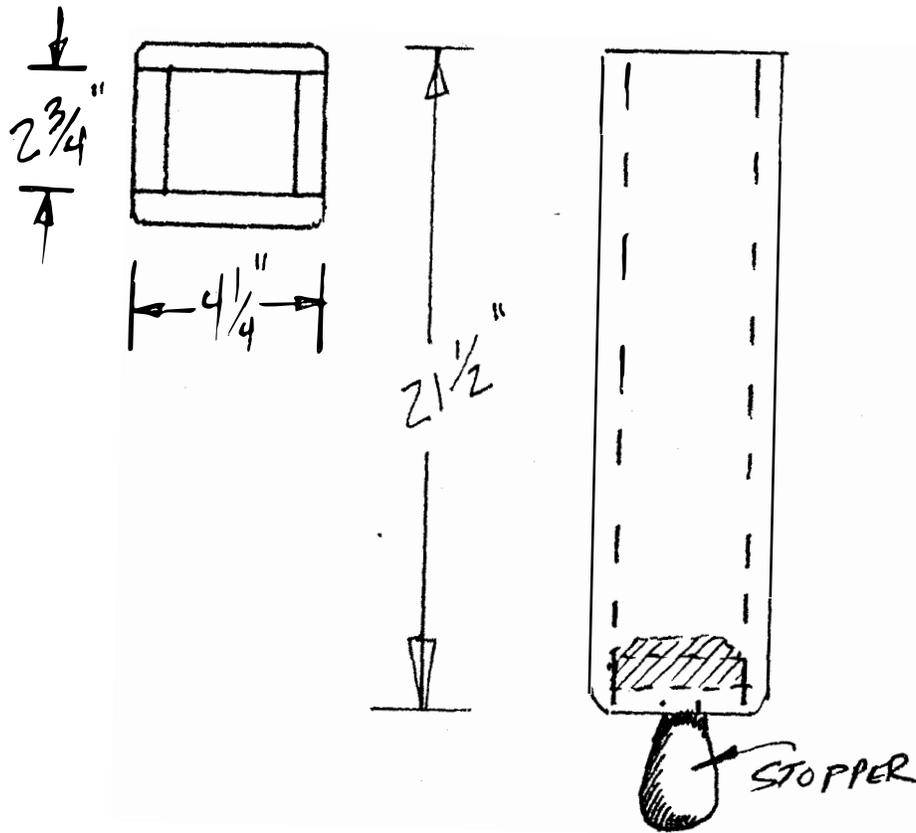
COLUMN RESONATOR - D3 (146.83Hz)



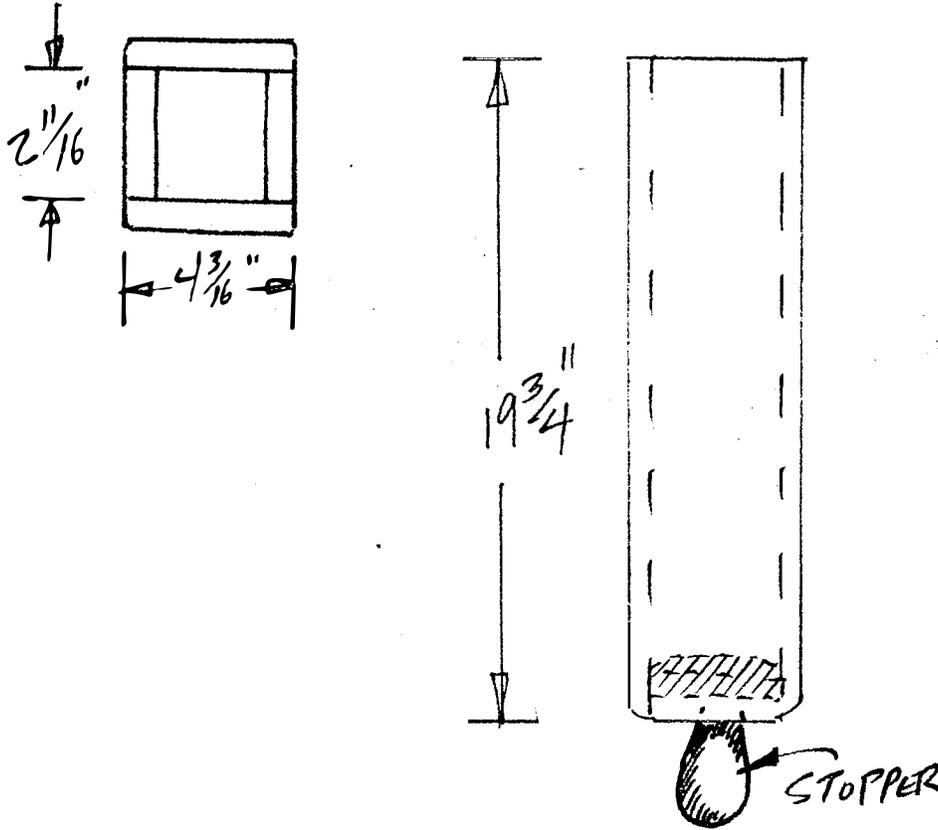
### COLUMN RESONATOR - D#3 (155.56Hz)



### COLUMN RESONATOR - E3 (164.81Hz)



### COLUMN RESONATOR - F3 (174.61Hz)



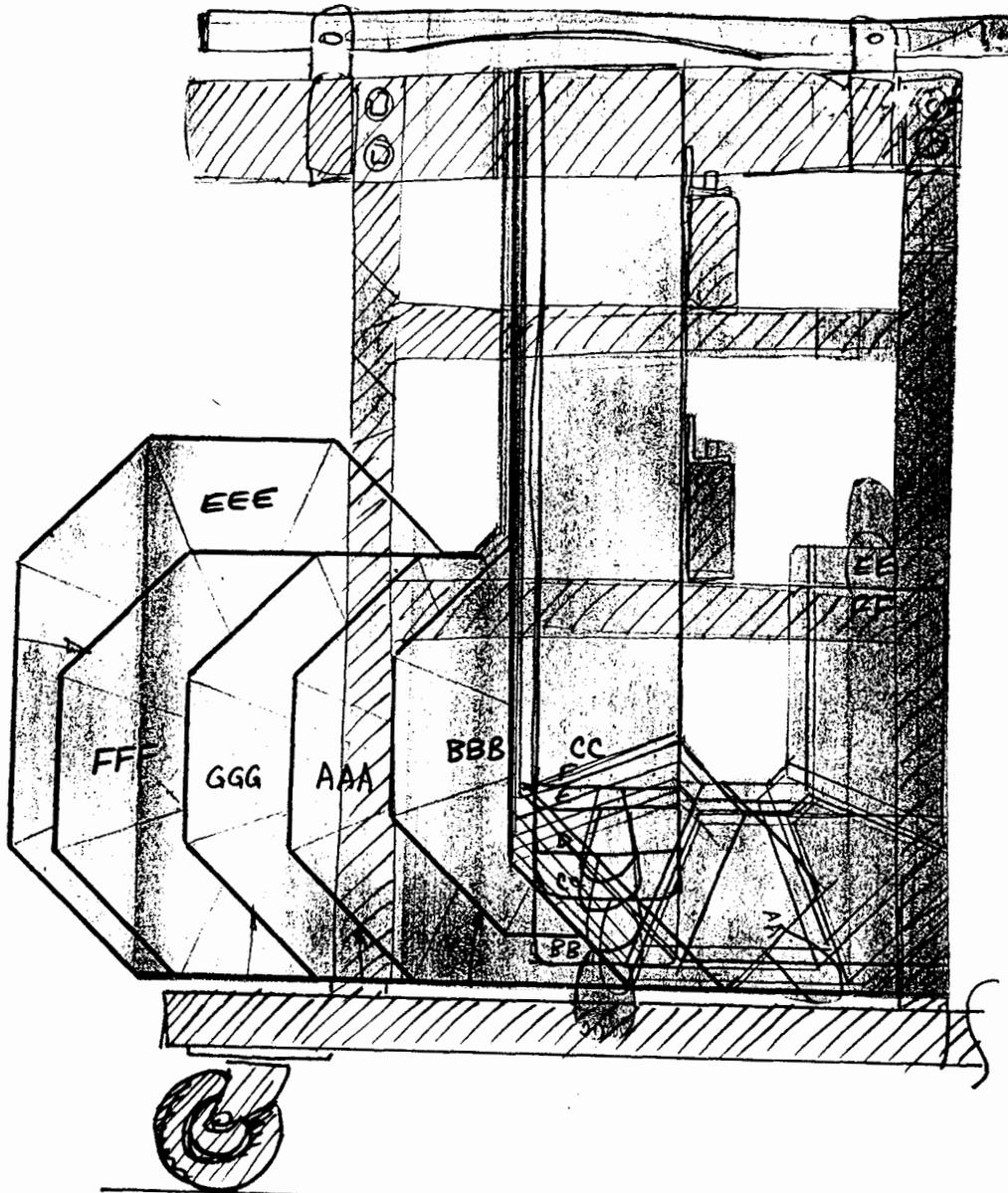
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## APPENDIX B

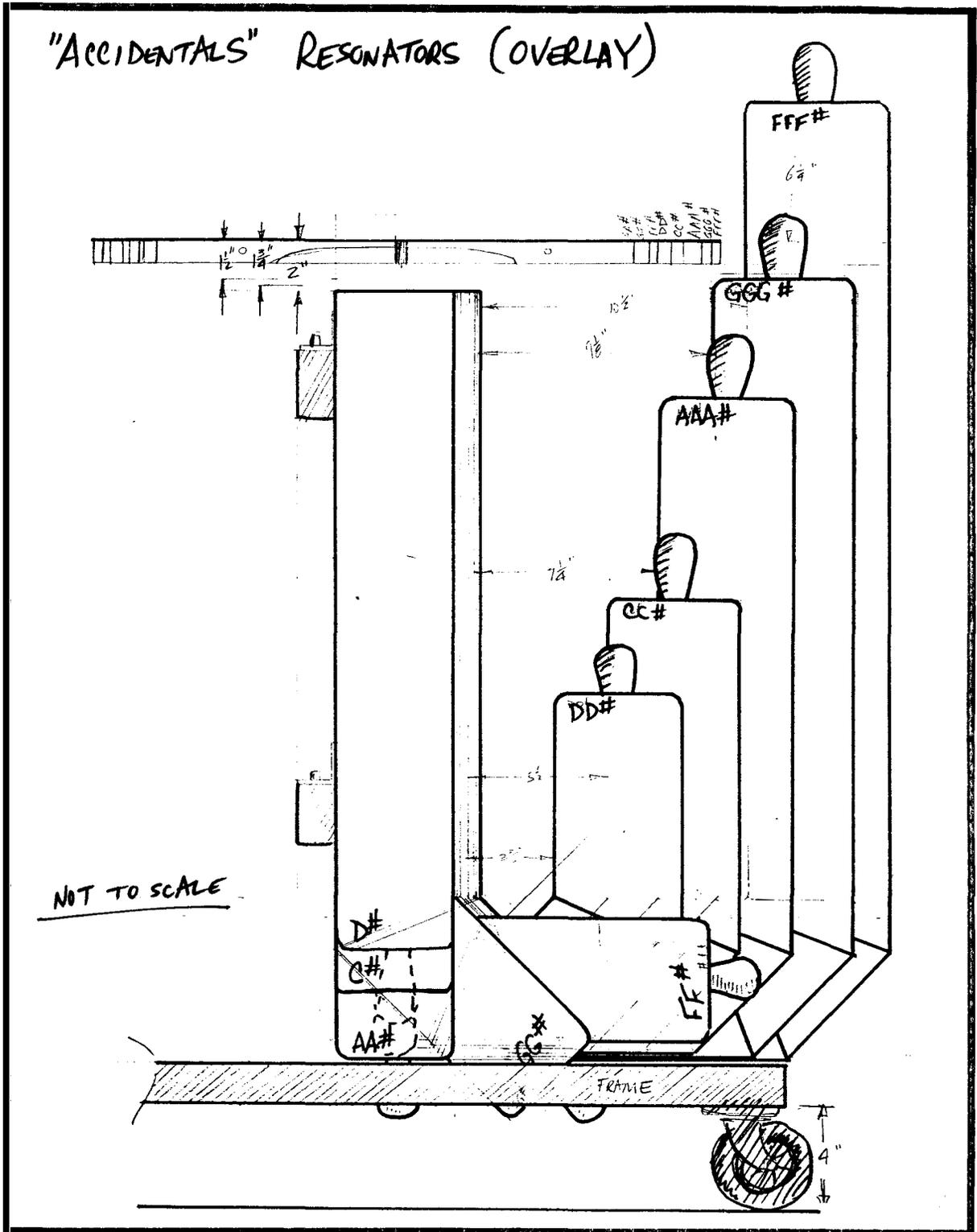
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### Design Data and Construction Information

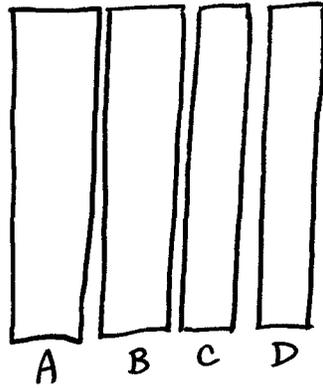
# "NATURALS" RESONATORS (OVERLAY)



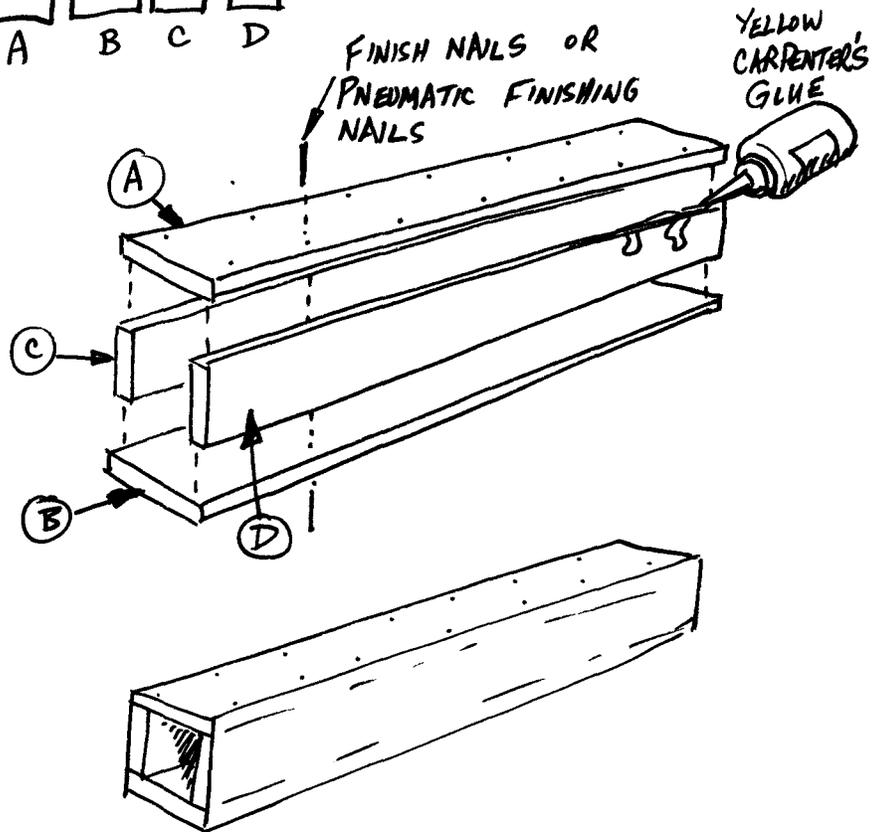
NOT TO SCALE



# RESONATOR ASSEMBLY



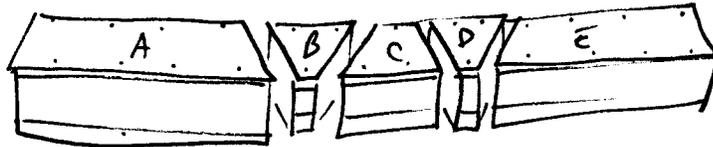
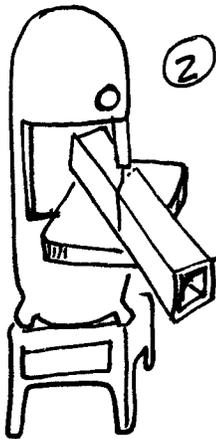
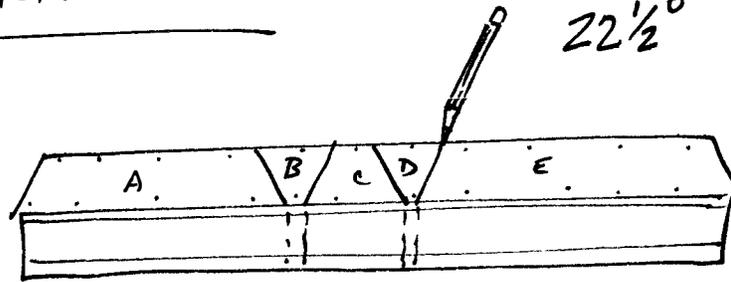
STOCK: WHITE PINE  
3/4" THICK



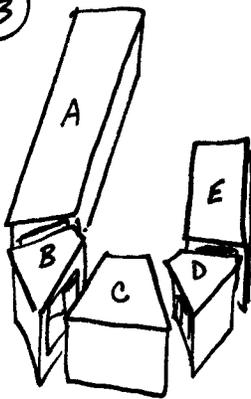
# MITERING

ANGLE:  
 $22\frac{1}{2}^{\circ}$

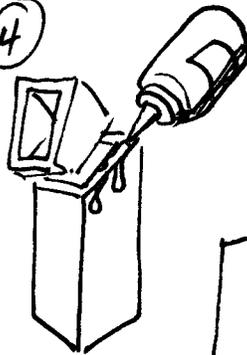
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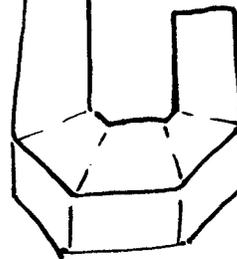
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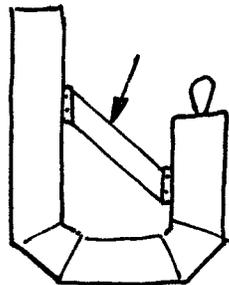
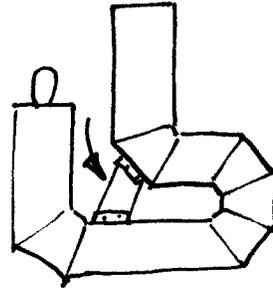
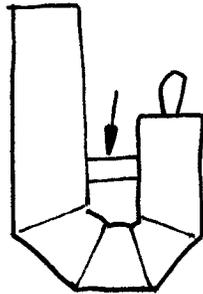
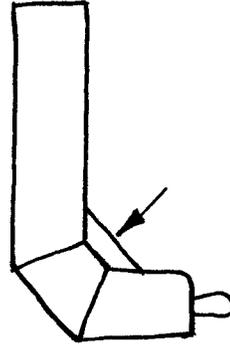
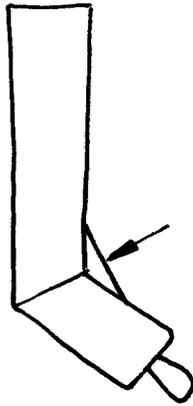
④



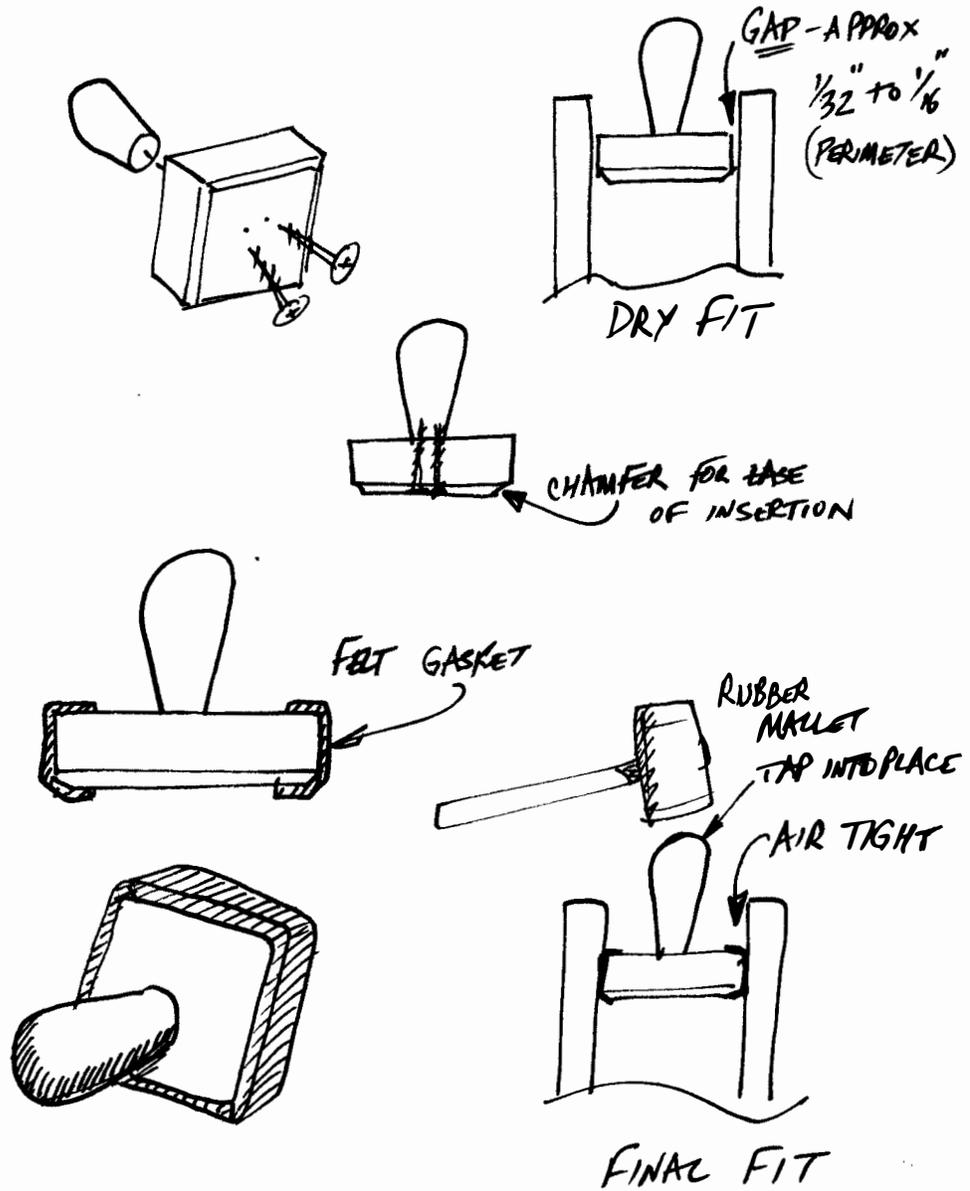
⑤



# RESONATOR BRACING

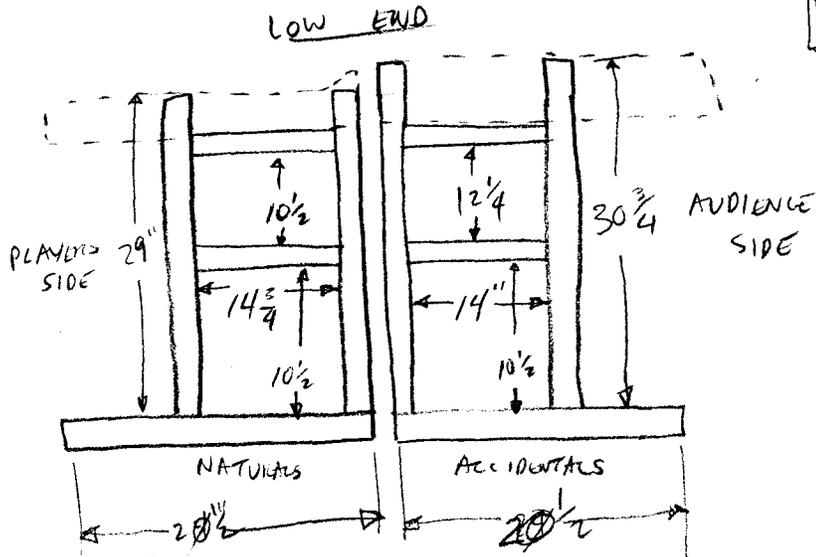
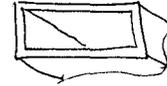


# RESONATOR STOPPER

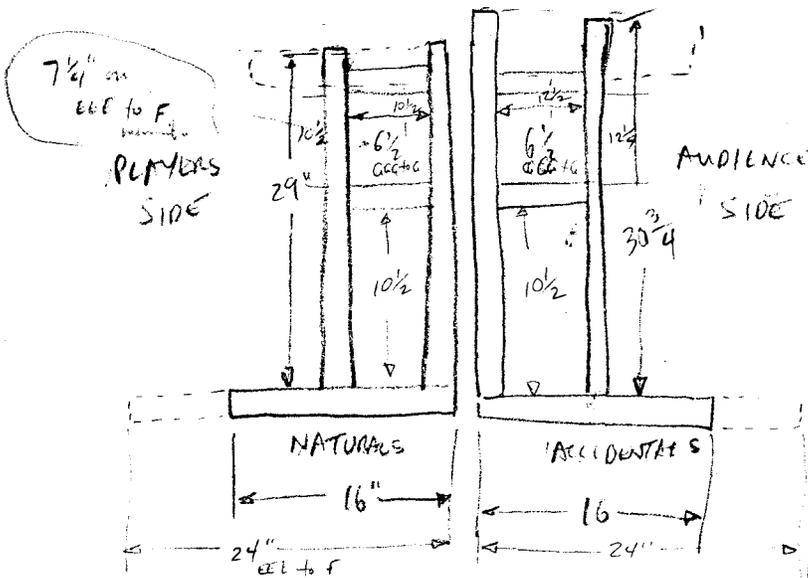


# FRAME

STOCK:  $1\frac{1}{2} \times 3 \times .125$   
ALUMINUM EXTRUDED TUBE



## HIGH END



BOLTS QTY'S

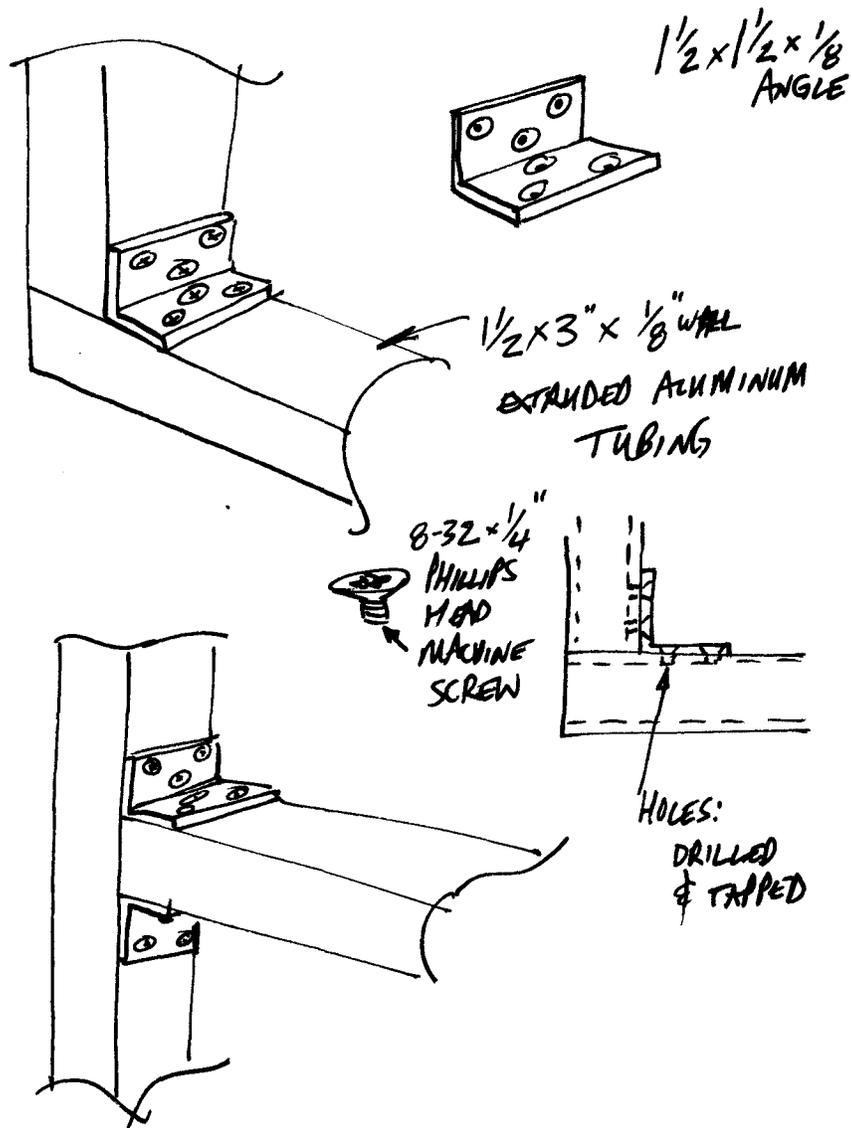
(16)  $4\frac{1}{2} \times \frac{5}{16}$

(4)  $3\frac{1}{2} \times \frac{5}{16}$

(4) WING NUTS

(16)  $4 \times \frac{5}{16}$

# FRAME (CONTINUED)





## ISSUES SURROUNDING THE DESIGN AND CONSTRUCTION OF THE SEMI-CONTRA BASS MARIMBA

### Pre-Fabrication Information

#### Significant Events In The Instrument's Design

- I discovered through microscopic inspection that a wood called "African Padouk" (pah-dook), sometimes referred to as *vermillion* due to its bright orange-red color, has a very similar pattern and weight as the Honduras Rosewood. Since the padouk is readily available in large straight-grained lengths (where the rosewood is not), it is viable alternative to the rosewood
- I was contemplating a change in frame materials. I was desiring to use rectangular-shaped extruded aluminum tubing if it was available. (The size in particular is 3" by 1 1/2" by 1/8" thick wall.) The idea was to remove the front cross-beam on the lower portion of the frame that I had used on all my earlier marimba projects. The aluminum would of course be more and less prone to flexing or breakage like wood. I also needed to work on a method of joining the aluminum pieces together.
- I wanted both C's (cello and tenor) to stand out from the other bars. Perhaps a plug of wood, such as a birch, imbedded in the center of the bar would work. This would provide the performer with instant reference points. On such a wide instrument where large physical movements are required, the references aid the performer and could make the difference between a hit or a miss on the upcoming note.

- For visual contrast, I felt it was necessary to paint the frame so it was different than the other two sub-systems; bars and resonators. While the bars and resonators were left in their natural wood hue. The frame required a contrasting color. The painted frame would also obscure the differences between the wood and aluminum parts.

### Significant Events In The Instrument's Construction And Function

#### *Construction*

- The aluminum frame parts required much attention to detail and precision using wood working tools. (Aluminum is usually soft enough to be cut and sanded with conventional wood working tools, but requires patience since cutting is slow.)
- To accommodate the cello and tenor C marking idea, I used a 1" diameter birch dowel section glued into a shallow hole in the bar. A problem occurred when sanding off the excess length [to make flush with the bar's surface] in that the friction caused by the belt sander caused the glue to soften, and the dowel plug would loosen as well. Once sanded flush, I re-glued the dowel plug which turned out to fit properly.
- The third harmonic (between the node point and the bar's end) was cut using only the width of the band saw blade. Only a single cut line was placed at the far end of the bar. Two cuts (one on the front end as well) would not have been practical because there was too much risk in the near end breaking if struck with a mallet.
- I tuned the third harmonic to be an octave above the 2nd harmonic, instead of an octave and a third above. This made all three modes (fundamental, 2nd harmonic, and 3rd harmonic) unisons of each other.

*Function*

- After the birch dowel was glued in place, the tenor C bar had an annoying buzz when struck with a mallet. Additional coats of varithane finish didn't work, so I had to fabricate a new bar and put a new birch dowel plug in as well.

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## APPENDIX C

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### Materials List

Engineering Design Specification - SEMI-CONTRA BASS MARIMBA (1985)

| <b>SEMI CONTRA BASS MARIMBA</b> |     |                                      |   |                   |
|---------------------------------|-----|--------------------------------------|---|-------------------|
| <b>MATERIALS LIST</b>           |     |                                      |   |                   |
|                                 |     |                                      |   | A/R = As Required |
| ITEM                            | QTY | DESCRIPTION                          | MATERIALS                                       | UNIT              |
| <i>BAR</i>                      |     |                                      |   |                   |
| 1                               | 26  | Bar                                  | African Padouk, 7/8" thick                      | 12.5 bd ft        |
| 2                               | -   | Bar finish                           | Paint, varithane, gloss                         | A/R               |
| 3                               | 104 | Bar alignment                        | Washer, felt, front-rail, med (piano punching)  | Each              |
| 4                               | -   | Bar suspension                       | Cord, nylon, fine-weave, 5/32"                  | 1 shank           |
| 5                               | -   | Bar identification                   | Punch, imprint, steel, 5/16"                    | A/R               |
| <i>RESONATORS</i>               |     |                                      |   |                   |
| 6                               | 26  | Resonators                           | White pine, 3/4" thick                          | 180 bd ft         |
| 7                               | -   | Adhesive                             | Alphatic resin (yellow carpenter's glue)        | A/R               |
| 8                               | -   | Bracing                              | White pine, 3/4" thick                          | A/R               |
| 9                               | 4   | Resonator finish                     | Paint, varithane, gloss                         | A/R               |
| 10                              | 26  | Resonator stopper                    | White pine, 3/4" thick                          | 5 bd ft           |
| 11                              | 26  | Resonator stopper handle             | Birch, dowel, 1-1/4" dia                        | A/R               |
| 12                              | 52  | Screws                               | 2" x 8, phillips, wood                          | Box               |
| 13                              | -   | Air-tight gasketing                  | Felt, medium                                    | 7 sq ft           |
| 14                              | -   | Adhesive                             | Hot glue, stick                                 | A/R               |
| <i>FRAME</i>                    |     |                                      |   |                   |
| 15                              | 2   | Bar support rail, naturals           | Fir, clear, 1-1/2" x 3-1/2"                     | A/R               |
| 16                              | 2   | Bar support rail, accidentals        | Fir, clear, 1-1/2" x 3-1/2"                     | A/R               |
| 17                              | 2   | End support rail, naturals           | White pine, 3/4" x 3-1/2"                       | A/R               |
| 18                              | 2   | End support rail, accidentals        | White pine, 3/4" x 5-1/2"                       | A/R               |
| 19                              | 4   | Frame support rails, naturals        | Alumimum extrud tubing, 3" x 1-1/2" x 1/8"      | A/R               |
| 20                              | 4   | Frame support rails, accidentals     | Alumimum extrud tubing, 3" x 1-1/2" x 1/8"      | A/R               |
| 21                              | 4   | Cross members, naturals              | Alumimum extrud tubing, 3" x 1-1/2" x 1/8"      | A/R               |
| 22                              | 4   | Cross members, accidentals           | Alumimum extrud tubing, 3" x 1-1/2" x 1/8"      | A/R               |
| 23                              | 2   | Base member, naturals                | Alumimum extrud tubing, 3" x 1-1/2" x 1/8"      | A/R               |
| 24                              | 2   | Base member, accidentals             | Alumimum extrud tubing, 3" x 1-1/2" x 1/8"      | A/R               |
| 25                              | 2   | Resonator support rails, naturals    | Fir, clear, 2" x 4"                             | A/R               |
| 26                              | 2   | Resonator support rails, accidentals | Fir, clear, 2" x 4"                             | A/R               |
| 27                              | -   | Frame component interface            | Aluminum, angle, 1-1/2" x 1-1/2" x 1/8"         | A/R               |
| 28                              | 200 | Screws                               | Flat head, phillips, zinc plated, 8 - 32 x 1/4" | A/R               |
| 29                              | -   | Frame finish                         | Lacquer, automotive, satin                      | A/R               |
| 30                              | 16  | Bar support assembly                 | Hex head, bolt, zinc plated 5/16" x 4-1/2"      | Each              |
| 31                              | 16  | Bar support assembly                 | Washer, zinc plated, 5/16"                      | Each              |
| 32                              | 16  | Bar support assembly                 | Nut, zinc plated, 5/16"                         | Each              |
| 33                              | 16  | Resonator support assembly           | Hex head, bolt, zinc plated 5/16" x 5-1/2"      | Each              |
| 34                              | 16  | Resonator support assembly           | Washer, zinc plated, 5/16"                      | Each              |
| 35                              | 16  | Resonator support assembly           | Nut, zinc plated, 5/16"                         | Each              |
| 36                              | 4   | Natural-Accidental halves together   | Hex head, bolt, zinc plated 5/16" x 3-1/2"      | Each              |
| 37                              | 4   | Natural-Accidental halves together   | Washer, zinc plated, 5/16"                      | Each              |
| 38                              | 4   | Natural-Accidental halves together   | Wing-nut, zinc plated, 5/16"                    | Each              |
| 39                              | 8   | Mobility                             | Caster, rubber, swivel, 4' dia                  | Each              |
| 40                              | 32  | Screws                               | Pan head, phillips, zinc plated, 3/4" x 12      | Each              |
| File: SEMICONT.XLS              |     |                                      |   |                   |

## APPENDIX D

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### Miscellaneous Data

### Exhibits and Displays

- November 1985 - Universal City, CA (Sheraton-Universal) - The Semi-Contra Bass Marimba was first exhibited at the Percussive Arts Society (PAS) convention.

### Live Performances

- May 3, 1986 (Saturday) - Pasadena, CA - Tilton's Trolley Stop with electric guitar, flute, and drums on Saturday May, 3 1986. A cassette tape titled "Bass Marimba Jazz" was created.
- June 16, 1990 (Saturday) - Pasadena, CA - Amedeo's Italian Fisherman Restaurant and Lounge with electric guitar, sax, and drums.



### Instrument Status

The Semi-Contra Bass Marimba has been donated to the University of Southern (USC) Music Department for use in their percussion studies and performances.