Wind Chime Classes

This is a series of classes on how to determine and fabricate a six tube set of wind chimes based upon the Pentatonic Scale. (Look at the set hanging in the Machine Shop.) I did an engineering analysis of how and why wind chimes function. The construction of them is based upon my analysis. This is a demonstration class only. If more than one part is needed only one will be demoed in the class. I will make the remainder out of class.   There will be not enough time for each person to make a set of their own chimes. If a person desires to make a set I will gladly assist them at a later date.

Class cost is $25 for Bodgery members. (I will teach the class for free as the funds will be donated to the Bodgey.) Class will be held at 1PM on each of the days listed below. Class size will be limited to 15. Copies of the software used for the chime calculation will be provided. Bring a data stick/thumb drive to first class to get your copy.

1 Oct. Chime theory and instruction on how to use spread sheet. Selection of desired chord and individual notes if you have tubes. Obtaining tubes and determining what chimes can be made.

9 Oct. Cutting tubes to length and drilling holes for hanging pins. Making of hanger pins and striker selection.

16 Oct. Top Hanger selection and fabrication.

23 Oct. Hanging of the tubes and striker. Sail fabrication. Clean-up.

Note: These day classes are estimates on my part of the time needed. A fifth class may be needed depending how fast things are accomplished in the previous classes.

Additional Info on Wind Chimes

These custom-made wind chimes resonant deep, rich, vibrant tones. These chimes use a six tube arrangement which is based upon the Major and Minor Pentatonic Scales. .There are 12 Chords in each scale with six notes per chord. These chords and be in any of the 8 octaves, giving many different set of notes which can be created into chimes. (See table at end.)

The equations for the frequency of vibration of the metal tubes were derived through the engineering analysis. (See Notes at end.) From the analysis it was determined that outside diameter, inside diameter, physical properties of the metal, i.e. speed of sound in the metal, Young's Modulus, etc. and the length of the metal used were the only physical factors which affected the frequency of vibration of the tube. With the factors, the length of the metal tube which would vibrate at a specific frequency could be determined.   A computer program was written to calculate the length of the tube to obtain the desired frequency of vibration; therefore, any set of notes on the piano can be made into a set of wind chimes,

Also the engineering analysis revealed that hanging points and impact point for the striker on the individual tubes had an effect on the quality of the tone of the tube. The computer program will also provide the correct hanging points and striking points for the desired frequency.

To ensure these chimes give life-long enjoyment, they are constructed of copper, brass, aluminum or stainless steel which will survive years of outdoor use. (Galvanized steel can be used but I discovered that the steel would begin to rust after a few years in the NC salt air environment. I also discovered that fabric material such as string, cotton cord, etc. do not last long in the outdoor environment.) These metals in the tubes will weather and slowly age, with the copper and brass giving a light-green patina while the aluminum will take on a white patina. The stainless steel hanging wire will also dine a life time of service.

Pentatonic Scales

		Minor Pentatonic Scale				
Chords		Notes				
C_{minor}	C	E^b	F	G	B^b	C
G_{minor}	G	B^b	C	D	F	G
D_{minor}	D	F	G	A	C	D
A_{minor}	A	C	D	E	G	A
E_{minor}	E	G	A	B	D	E
B_{minor}	B	D	E	$F^\#$	A	B
$F^\#{}_{minor}$	$F^\#$	A	B	$C^\#$	E	$F^\#$
$D^b{}_{minor}$	D^b	E	G^b	A^b	B	D^b
$A^b{}_{minor}$	A^b	B	D^b	E^b	G^b	A^b
$E^b{}_{minor}$	E^b	G^b	A^b	B^b	D^b	E^b
$B^b{}_{minor}$	B^b	D^b	E^b	F	A^b	B^b
F_{minor}	F	A^b	B^b	C	E^b	F

		Major Pentatonic Scale				
Chords		Notes				
C_{major}	C	D	E	G	A	C
G_{major}	G	A	B	D	E	G
D_{major}	D	E	$F^\#$	A	B	D
A_{major}	A	B	$C^\#$	E	$F^\#$	A
E_{major}	E	$F^\#$	$G^\#$	B	$C^\#$	E
B_{major}	B	$C^\#$	$D^\#$	$F^\#$	$G^\#$	B
$G^b{}_{major}$	G^b	A^b	B^b	D^b	E^b	G^b
$D^b{}_{major}$	D^b	E^b	F	A^b	B^b	D^b
$A^b{}_{major}$	A^b	B^b	C	E^b	F	A^b
$E^b{}_{major}$	E^b	F	G	B^b	C	E^b
$B^b{}_{major}$	B^b	C	D	F	G	B^b
F_{major}	F	G	A	C	D	F

The notes in the Major and Minor Pentatonic Scales

FORMULAS

Formula for Frequency:

$$w = c\sqrt{}(EgI/\delta L^4)$$

Where:

w = frequency
c = constant for open end boundary condition: 3.56
E = Bulk Modulus of Elasticity of metal being used.
g = acceleration of gravity: 386.4 inches/seconds^2
d = mean diameter of tube: (Diameter$_{outside}$ + Diameter$_{intside}$)/2
t = thickness of tube wall
ρ = Density of metal being used.
I = Area Mass Moment of Inertia: $\pi d^3 t/8$
L = Length of tube
δ = Mass per unit length: $\pi dt\rho$

Substituting and Reducing

$$w = c(d/L^2)\sqrt{}(Eg/8\delta)$$

Solving for Length

$$L = \sqrt{}(cKd/w)$$

This is the equation which will be used in the spread sheet to calculate the length of the tube to obtain the desired frequency (note).

Where

$$K = \sqrt{}(Eg/8\delta)$$