ELECTROMECHANICAL ANALYSIS LAB
EMET 3424_70
TUESDAY, MARCH 20, 2001
8:00 – 9:50AM, SET 363

LAB#8

CENTER OF PERCUSSION ANALYSIS

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LAB OBJECTIVE

The objective of this laboratory experiment is to gain experience and practice working with electrical devices. We will look at how a scotch yoke mechanism converts circular motion into linear motion. There are many ways to measure velocity. We will look at three, tachometer, oscilloscope, and velocity transducer.

The equipment used in this lab is listed but limited to this list.

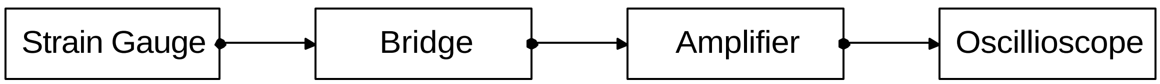
- Tektronix TDS 310 Two Channel Oscilloscope, S/N: B040281, Instr. TDS310, Voltage Range: 90 – 132 V, Frequency Range: 47 – 440 Hz
- Semiconductor Strain Gauge
- Wheatstone Bridge w/ 120 Ω
- Amplifier

CENTER OF PERCUSSION ANALYSIS

THEORY

The center of percussion is the point on a bar that when stuck will causes a zero force in the direction of struck. The center of percussion is different deepened upon the geometry. If the geometry is a flat bar, the center of percussion is at two thirds of the length of the bar. The center of Percussion can help when designing many derives in that it can reduce vibration and damages caused by unwanted forces, such as in the case of an automatic nailer.

FIGURE 1: BLOCK DIAGRAM CENTER OF PERCUSSION



The strain gauge measures the strain caused by the force component in the x direction. Then the bridge converts that reading to at voltage. The amplifier makes it easy to read and compare. Last the Oscilloscope displaces the peak to peak voltage verses time.

FIGURE 2: WEIGHT EQUATION

$$\mathrm{Weight} := \mathrm{SpWeight} \cdot \mathrm{Vol}$$

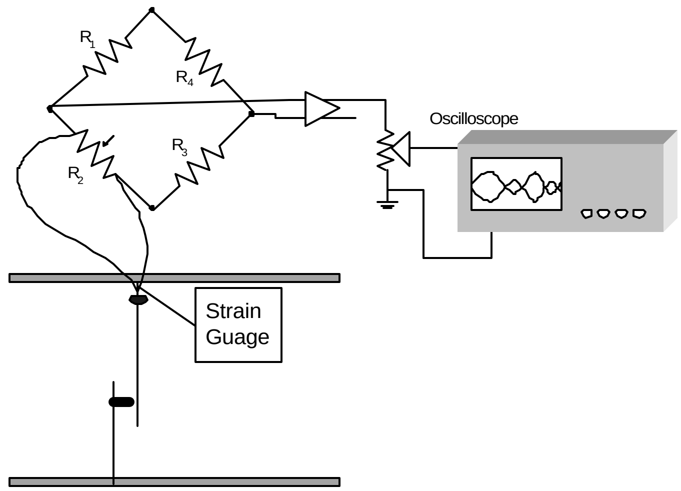
FIGURE 3: FORCE IN THE X-DIRCTION

$$P := \frac{\mathrm{Weight} \cdot \mathrm{Length}^2 \cdot \alpha}{3 \cdot \mathrm{Dis}}$$

$$A_x := \frac{\mathrm{Weight} \cdot \mathrm{Length} \cdot \alpha}{2} - P$$

SCHEMATIC

FIGURE 4: MECHANICAL SETUP



PROCEDURE / DATA COLLECTION

The setup is such that a bar hangs from a pivoted point and a strain gauge is anteceded to the top point. We measure the length of the bar. Then calculate the location of the center of percussion in ½ inch increments. Set the stop bar at the furthermost point away from the center of percussion. Raise the bar and let it go. Capture the voltage waveform on the oscilloscope. Note the magnitude and direction of force. Repeat for the other positions.

CALCULATIONS

$$\text{Length} := 11 + \frac{11}{16}$$

$$\text{Vol} := 1 \cdot \frac{1}{4} \cdot \text{Length}$$

$$\text{SpWeight} := .284144$$

$$\text{Weight} := \text{SpWeight} \cdot \text{Vol}$$

$$\theta := 23$$

$$\alpha := \left(\frac{3}{2}\right) \cdot \left(\frac{386.088}{\text{Length}}\right) \cdot \cos(\theta)$$

$$\text{Dis} := \left(\frac{1}{3}\right) \cdot \text{Length}$$

$$P := \frac{\text{Weight} \cdot \text{Length}^2 \cdot \alpha}{3 \cdot \text{Dis}}$$

$$A_x := \frac{\text{Weight} \cdot \text{Length} \cdot \alpha}{2} - P$$

$$A_x = 128.097$$

$$\text{Length} := 11 + \frac{11}{16}$$

$$\text{Vol} := 1 \cdot \frac{1}{4} \cdot \text{Length}$$

$$\text{SpWeight} := .284144$$

$$\text{Weight} := \text{SpWeight} \cdot \text{Vol}$$

$$\theta := 23$$

$$\alpha := \left(\frac{3}{2}\right) \cdot \left(\frac{386.088}{\text{Length}}\right) \cdot \cos(\theta)$$

$$\text{Dis} := \left(\frac{2}{3}\right) \cdot \text{Length}$$

$$P := \frac{\text{Weight} \cdot \text{Length}^2 \cdot \alpha}{3 \cdot \text{Dis}}$$

$$A_x := \frac{\text{Weight} \cdot \text{Length} \cdot \alpha}{2} - P$$

$$A_x = 0$$

$$\text{Length} := 11 + \frac{11}{16}$$

$$\text{Vol} := 1 \cdot \frac{1}{4} \cdot \text{Length}$$

$$\text{SpWeight} := .284144$$

$$\text{Weight} := \text{SpWeight} \cdot \text{Vol}$$

$$\theta := 23$$

$$\alpha := \left(\frac{3}{2}\right) \cdot \left(\frac{386.088}{\text{Length}}\right) \cdot \cos(\theta)$$

$$\text{Dis} := \left(\frac{3}{3}\right) \cdot \text{Length}$$

$$P := \frac{\text{Weight} \cdot \text{Length}^2 \cdot \alpha}{3 \cdot \text{Dis}}$$

$$A_x := \frac{\text{Weight} \cdot \text{Length} \cdot \alpha}{2} - P$$

$$A_x = -42.699$$

RESULTS SUMMARY

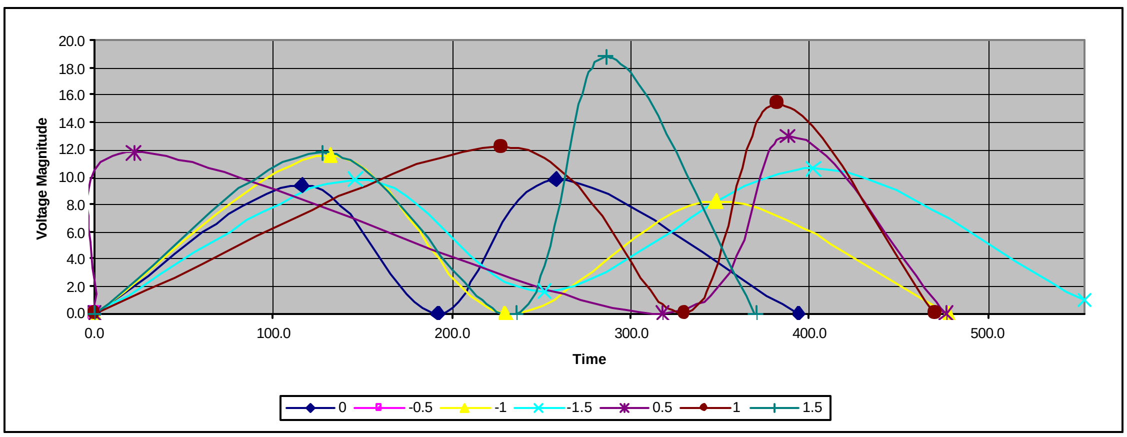
TABLE 1: FORCE CALULATIONS

			Distance	Force (Ax)
Length	11.6875			
Volume	2.921875		6.292	-56.84839
SpWeight	0.284144		6.792	-35.10882
Weight	0.830233		7.292	-16.35068
Deg	23		7.792	0
Area	49.14743		8.292	14.37874
Distance	7.791667		8.792	27.12198
			9.292	38.49375

TABLE 2: VOLTAGE MEASURMENTS DATA

-1.5		-1		-0.5		0		0.5		1		1.5	
6.25		6.75		7.25		7.75		8.25		8.75		9.25	
$Voltage_{pp}$	Time	$Voltage_{pp}$	Time	$Voltage_{pp}$	Time	$Voltage_{pp}$	Time	$Voltage_{pp}$	Time	$Voltage_{pp}$	Time	$Voltage_{pp}$	Time
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.8	146.0	11.6	132.0	11.8	248.0	9.4	116.0	11.8	22.0	12.2	228.0	11.8	128.0
1.6	252.0	0.0	230.0	0.0	350.0	0.0	192.0	0.0	318.0	0.0	330.0	0.0	236.0
10.6	402.0	8.2	348.0	9.8	436.0	9.8	258.0	13.0	388.0	15.4	382.0	18.8	286.0
1.0	554.0	0.0	478.0	1.0	588.0	0.0	394.0	0.0	476.0	0.0	470.0	0.0	370.0

FIGURE 5: VOLTAGE MEASURMENTS GRAPH



DISCUSSION

We can see that the center of percussion for a flat bar in is in fact at two thirds the length. We have also proven the use of the given equation to find the component of the force in the x direction. However we also found that the down fall of the setup that was used is that is it to sensitive and may have effect some of our readings.

LAB SHEET

NOTES

ORGINAL DATA