Template for MAE3 Clock Point Mass Analysis

Tips for using MathCAD

- Text and math (equations) are included as separate parts of the document to make up a report with values that can be calculated and updated automatically
- Use the "Text Block" button to insert text that stretches across the page width and pushes other content down the page
- Use the "Text Box" button to insert text labels next to equations
- Use the "Math" button to insert equations with values and units
- Use the assignment opertator ":=" to assign a value to a variable
- Use the equation operator "=" to calculate a value based on a defined equation
- Use the "Operators and Symbols>Symbols" button to insert greek letters like ρ

Pendulum Point Mass Analysis

Name:
Section:

Problem Description

Objective

Assumptions

CAD Geometry Values

Insert figures of pendulum with dimensions and Inventor mass properties here

Calculating Center of Mass of Pendulum

Variable	Value/ Equation [*units*]
Calculate Weight of Acrylic	
Area	$A := 99.35\ cm^2$
Thickness	$t := 0.610\ cm$
Volume	$V := A \cdot t = 60.604\ cm^3$
Density	$\rho := 1188\ \frac{kg}{m^3}$
Calculated Weight of Acrylic	$W_{calc} := V \cdot \rho = 0.072\ kg$
Measured Weight of Acrylic	$W_{meas} := 0.0698\ kg$
% Error in Acrylic Weight Estimate	$W_{error} := \left\lvert \frac{W_{calc} - W_{meas}}{W_{calc}} \right\rvert \cdot 100 = 3.051$
Calculate Center of Mass of Acrylic Relative to Pivot Point	
Length of Center of Mass of Acrylic from Inventor	L_{model}
Estimate Center of Mass of Acrylic	L_{est}
Percent Error in Acrylic Center of Mass Estimate	L_{error}
Calculate Total Weight of Pendulum	
Weight of one bolt plus one nut	W_b
Number of bolts	N
Calculated total weight of pendulum with bolts and nuts	W_{t_calc}
Measured total weight of pendulum with	W_{t_meas}
Percent Error in total pendulum weight estimate	W_{error}
Calculate Center of Mass of Pendulum with Bolts	
Length to center of mass of bolt 1	L_{b1}
Length to center of mass of bolt 2	L_{b2}
Length to center of mass of bolt 3	L_{b3}
....	
<add rows as required for number of bolts>	
Length to center of mass of acrylic with bolts and nuts	L_{com}
Estimated center of mass of acrylic with nuts and bolts	L_{com_est}
Percent error in acrylic with bolts Lcom estimate	L_{com_error}

Calculate Natural Frequency and Timing Using Point Mass Assumption

Natural Frequency in rad/s	f
Natural Frequency in Hz	f
Period of Oscillation	T
Number of teeth in escapement wheel	N_{teeth}
Calculated time of one revolution of escapement wheel	t_{calc}
Measured time of one revolution of escapement wheel	t_{meas}
Percent error in clock timing	t_{error}

Discussion