

NANYANG TECHNOLOGICAL UNIVERSITY
School of Mechanical and Aerospace Engineering

EXPERIMENT E3.1: DYNAMIC OR TUNED VIBRATION ABSORBER

LOG SHEET

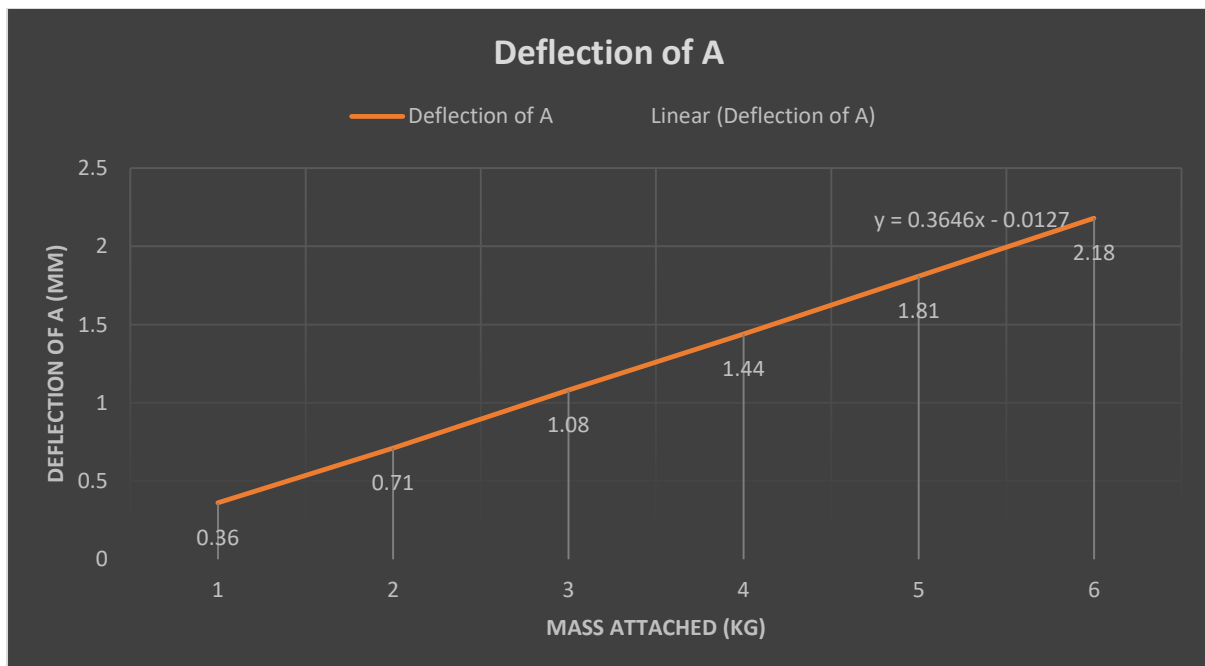
Name: Cornelius Tong An Shen

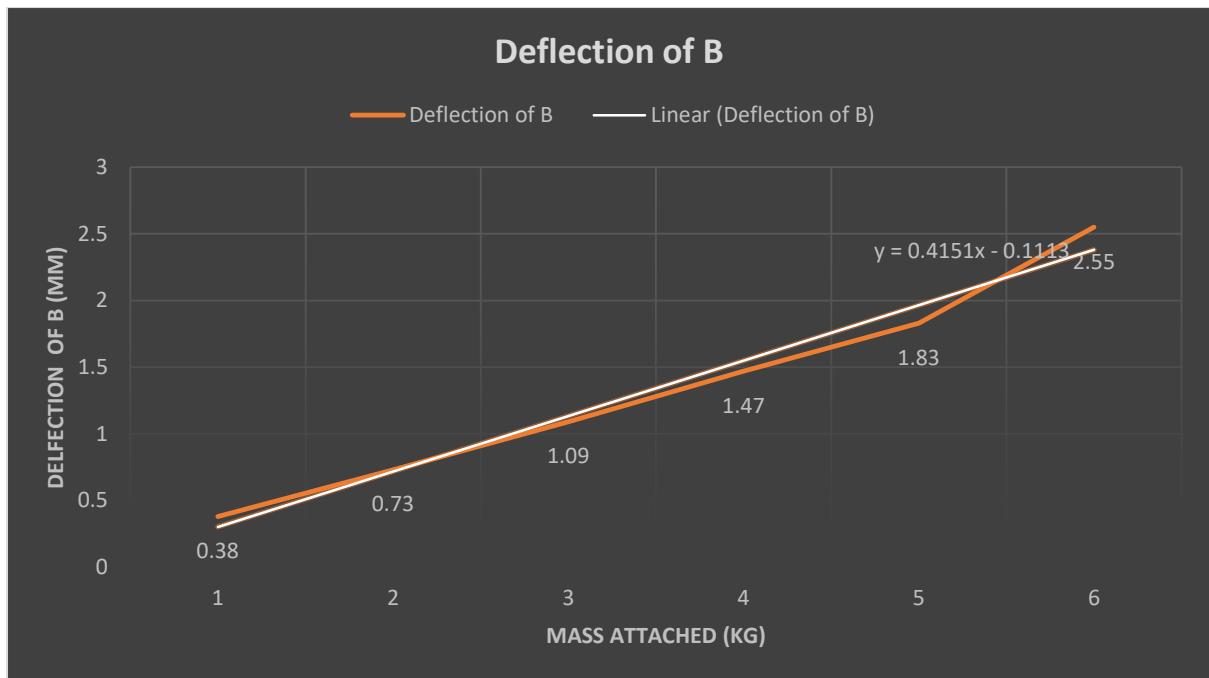
Date: 04/02/2021 Time: AM / ~~PM~~

Submit To: Dr. MAE Milan Paudel

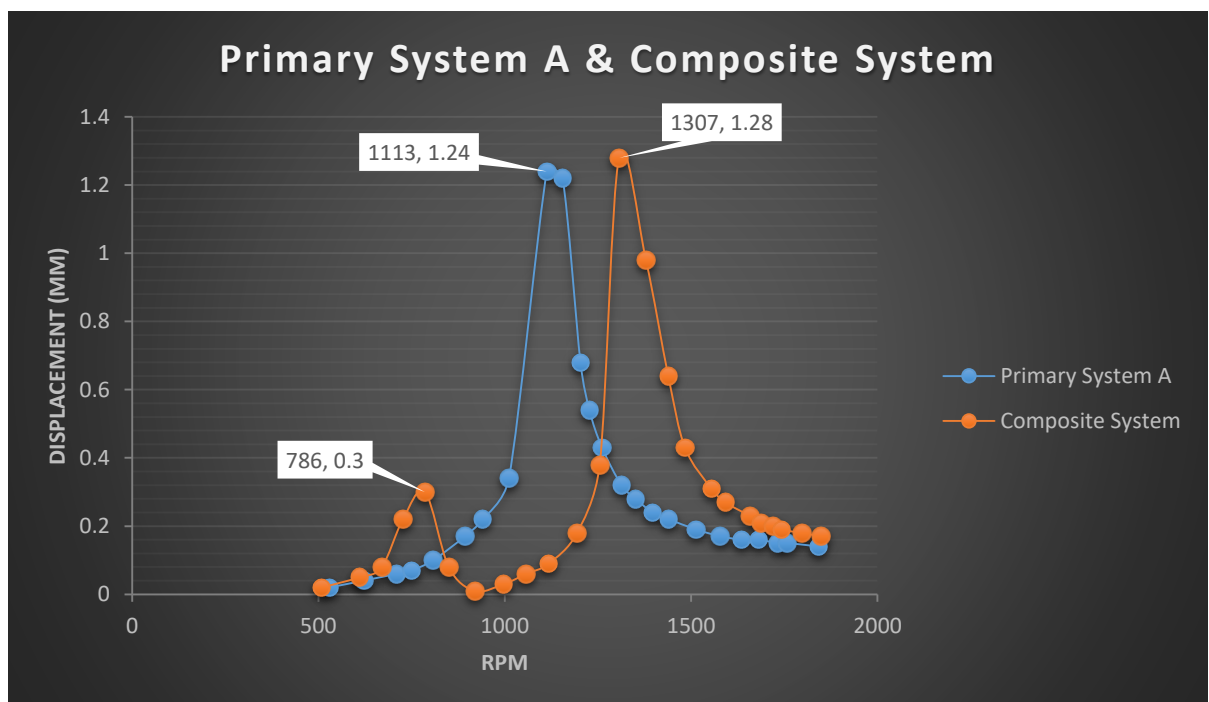
6. RESULTS

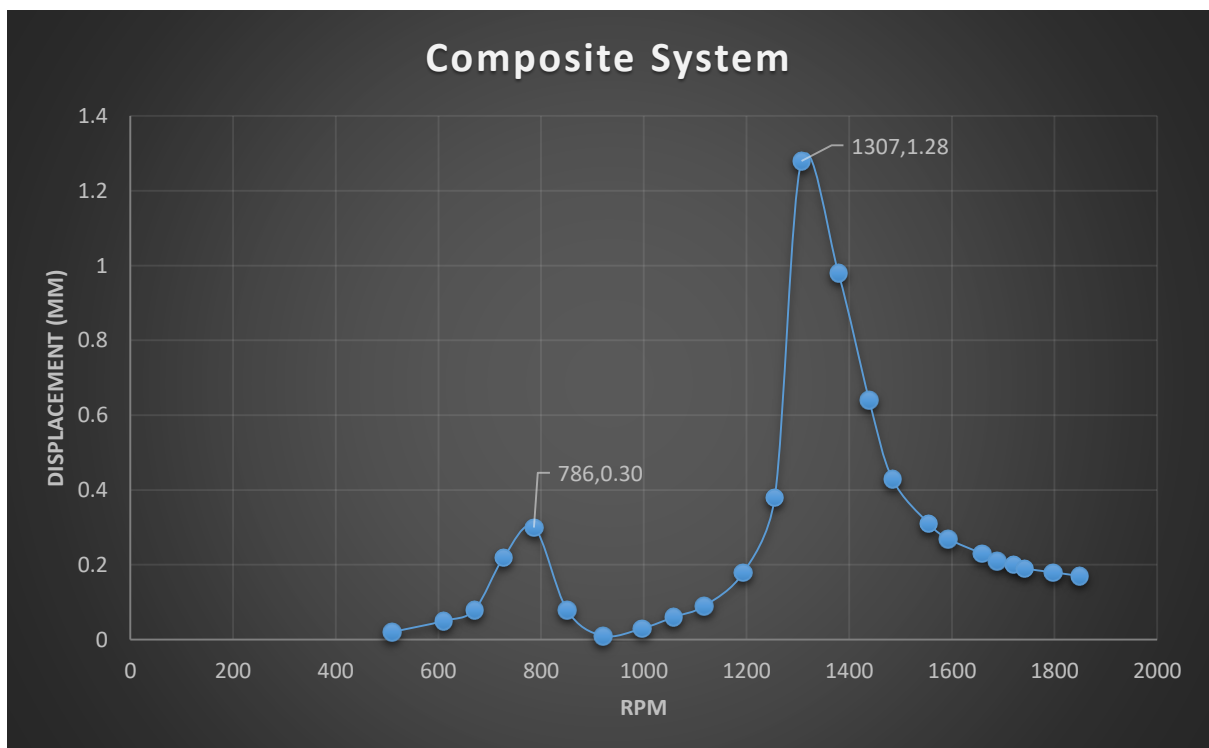
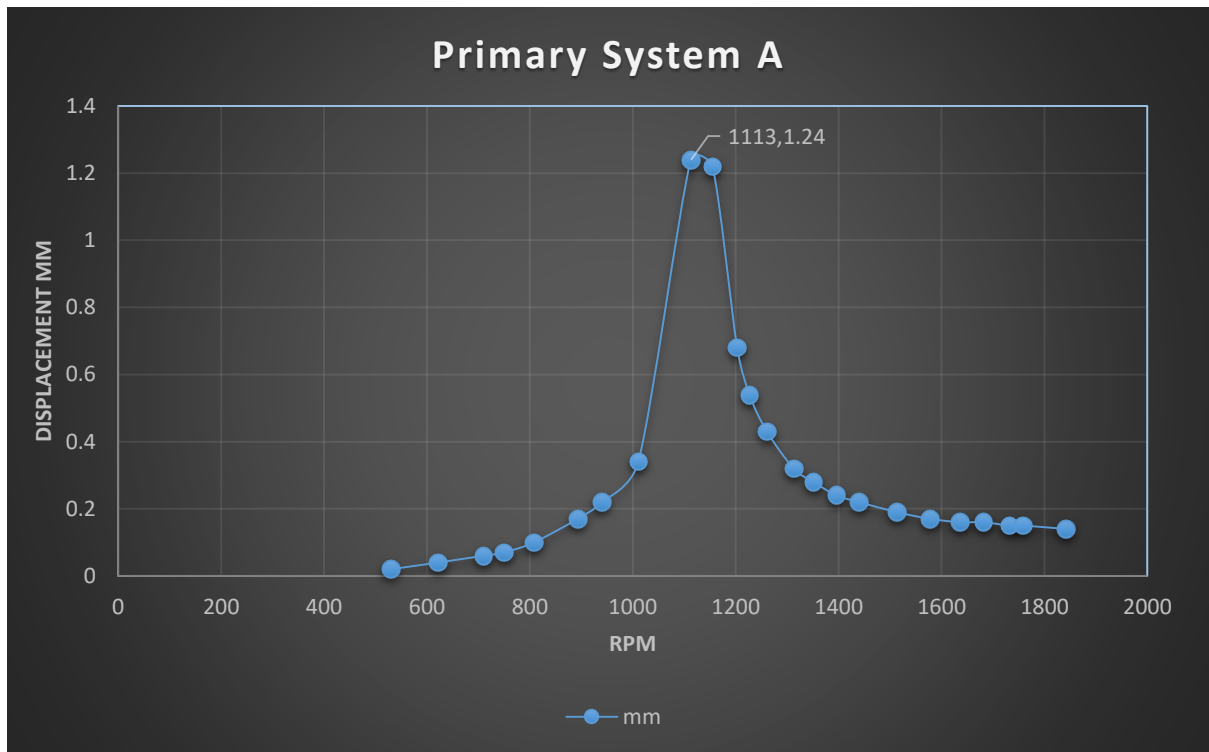
6.1 Plot the graph of spring deflection against load and determine the average spring stiffness for the system.





6.2 Plot the dynamic displacement against speed curves for the primary system and the composite system





7. DISCUSSION

a) Comment on the spring stiffnesses obtained experimentally.

From the graph A, we can infer a linear relationship between the displacement and the force applied upon it as gravity is a constant. By means of using a best fit line, we can utilize its gradient and the following formula to approximate its stiffness value.

$$k = \frac{Mg}{2y} = \left(\frac{y}{M}\right)^{-1} * \frac{g}{2}$$

$$*g = 9.81 \text{ m/s}^2$$

Since A is 0.3646 mm/kg, $k = 13.453 \text{ N/mm} = 13453.10 \text{ N/m}$

Since B is 0.4151 mm/kg, $k = 11.816 \text{ N/mm} = 11816.43 \text{ N/m}$

- b) What are the resonant frequencies of the primary and composite systems?
Hence, comment on the effectiveness of the dynamic absorber.

$$*RPM = Hz * 60$$

Primary System		Composite System	
RPM	Frequency (Hz)	RPM	Frequency (Hz)
1113	18.55	786	13.1
		1307	27.78

The effectiveness of the dynamic absorber is within the range of $786 < RPM < 1307$. This covers the natural frequency of the primary system.

- c) Calculate the theoretical natural frequency of the absorber and compare it with the experimental result.

$$I = \frac{\pi}{4} * 0.003^4 = 6.36 * 10^{-11}$$

$$A = \pi * 0.003^2 = 2.83 * 10^{-5}$$

$$\omega = \left[\frac{3EI}{\left(M + \frac{33\rho AL}{140}\right)L^3} \right]^{\frac{1}{2}} = \left[\frac{3 * 201 * 10^9 * 6.36 * 10^{-11}}{\left(0.023 + \frac{33 * 7860 * 2.83 * 10^{-5} * 0.41}{140}\right)0.41^3} \right]^{\frac{1}{2}}$$

$$= 111.83 \frac{rad}{s} = 17.8 \text{ Hz}$$

Natural frequency of absorber system.

No.	ω_n (Hz)
1	15.81
2	15.84
3	15.80
Average:	15.817

$$\% Error_{15.81} = \frac{17.8 - 15.81}{17.8} = 11.18\% \quad \% Error_{15.84} = \frac{17.8 - 15.84}{17.8} = 11.01\%$$

$$\% Error_{15.80} = \frac{17.8 - 15.80}{17.8} = 11.24\%$$

The discrepancy between the values are considerable with errors up to 11.24%. This error may be part in due to loosening of the screws for the vibration meter and the absorber. It may also be due to inaccuracies in the vibration meter due to suboptimal calibration or defects.

d) Any other comments.

Experiment was very interesting to see the effect of vibrations on structures. Though I have not taken the Solid Vibration module, one would intuitively think that the amplitude would increase proportionally with RPM. This experiment sheds light on my lack of knowledge and grants upon me more questions to ponder about. Thank you.