

Key equations

Quantity	Equation	Notes
Area	$A = w t$	Rectangular beam cross-section; w width, t thickness
Area moment of inertia	$I = w t^3 / 12$	Textbook form (post's equation is an image)
Cantilever natural frequency	$\omega_n = (1.875)^2 \sqrt{E I / (\rho A L^4)}$	First mode, textbook form; $f = \omega_n / 2\pi$
Percent error	$ f_{\text{exp}} - f_{\text{th}} / f_{\text{th}} \times 100$	Measured vs theoretical frequency
Length scaling (mine)	$f \propto 1 / L^2$	150 mm beam is about 2.8 times the 250 mm frequency
Sampling limit (mine)	Sample rate $> 2 f$	Nyquist criterion; below it the signal aliases

Key takeaways

- Setup: thin aluminum beam clamped between steel plates, piezo sensor, LabVIEW. Free lengths 250, 200, 150 mm.
- Method: flick the free end, record the decay, repeat at sampling rates 5, 10, 50, 100, 200.
- Post's findings: at 100 and 200 the error was 12.59 to 4.64%; at 5 and 10 the error was 91.26 to 97.6%.
- Longer beams had lower frequency and, at the same sampling rate, lower percent error.
- Lesson: pick the sampling rate from the expected frequency first, then go well above twice that value.
- Mine: the huge errors at 5 and 10 are consistent with sampling too slowly to capture the oscillation, not with beam theory being wrong.
- Post gives no results for rate 50, and its beam dimensions and material table are images, so recompute with your own E, ρ , w and t.

Test matrix from the post

Free length	Sampling rates	Figures in post
250 mm	5, 10, 50, 100, 200	Figs 6 and 7 (200 and 5)
200 mm	5, 10, 50, 100, 200	Figs 4 and 5 (200 and 5)
150 mm	5, 10, 50, 100, 200	Figs 2 and 3 (200 and 5)