Tutorial 5, Oct 15, 2021

- $P_e = P_{crit} = \dfrac{\pi^2 EI}{L^2}$
- For a beam cross section $I = \dfrac{bh^3}{12}$ where h is the height and b is the width, and the bending axis is horizontal (b is along the bending axis)
- Strong vs weak bending use different axes
- When compressing a beam it always buckles so to bend in the direction with less I

Buckling Lab

- For this experiment $E = 73000$MPa
- Vertical axis is normalized to be $\dfrac{P}{A}$ (stress) and the horizontal axis is normalized to use $\dfrac{L}{r}$, where r is the *radius of gyration* ($\dfrac{L}{r}$ is the *slenderness ratio*)
- Type is Short or Long
- t is the thickness of the aluminum strip

Type	t (mm)	W (mm)	L (mm)	I (mm^4)	P_e (N)	Exp P_e (N)	Test/Prediction
S1	3.29	12.74	100	37.8	2724	2136	0.78
S2	3.30	12.75	99	38.2	2807	2200	0.78
S3	3.30	12.76	100	38.2	2753	2160	0.78
S_{avg}	3.30	12.75	99.7	38.7	2761	2165	0.78
L1	3.20	25.41	199	69.4	1262	920	0.73
L2	3.21	25.44	200	70.1	1263	960	0.76
L3	3.20	25.40	199	69.4	1262	864	0.68
L_{avg}	3.20	25.42	199	69.6	1262	914	0.72

Observations

- Buckling happens without warning
- Strengths are systematically off, indicating something more than random noise
- The longer ones are twice as long and twice as wide, which means they are about half as strong