The dimensions of the specimens, I beam and rectangular section, are shown above. The moments of inertia compute to:

\[ I_{\text{beam}} = 0.0279 \text{ in}^4 \quad I_{\text{rectangular}} = 0.0106 \text{ in}^4 \]

Both show approximately the same area \( \sim 0.213 \text{ in}^2 \).

A mistake made by near all was to take the length \( L \) as the full length of the beam (misguided, no doubt by my figure). \( L \), as it figures into engineering beam theory, is the length between the two support points. These two points are at the top of the rollers; hence the distance between the axes of the rollers is \( L \). This, for all four setups was 22 inches (not 24).

The dimension \( a \) could vary from setup to setup. But since the support points of the hanging cables were 3 inches off center, approximately, \( a \sim 8 \text{ inches} \).

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The next page shows the results - of all groups.

The first thing to note is the consistency of the data obtained by all groups. I have corrected for errors made by some groups in carrying out the reduction of the op-amp data to stress values.

The second thing to note is the linearity of the experimental results. I leave it to you to sketch in (with a straight edge) a linear fit to the load displacement data and compare the slope - the stiffness - with that of the lines shown, which were obtained from engineering beam theory.

The third thing to note is the relatively good fit (within ?? %) of theory with experiment. (You should compare percentage difference of slopes).

Finally you should note the advantage of using a beam with an I section relative to using a rectangular section of the same cross-sectional area, and hence the same amount of material. The maximum bending stress is lower for the same applied load (by a factor of ??) and the displacement less (by a factor of ???.)
\[ w_{\text{midspan}} = \left( \frac{Pa}{24EI} \right) \cdot (3L^2 - 4a^2) \]

\[ P = \frac{W}{2} \]

Load versus Displacement

Max. Normal Bending Stress - psi

\[ \sigma_x = \frac{M_y \cdot \left( \frac{h}{2} \right)}{I} \]

\[ 8 \times 10^3 \]

Summarized Results

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