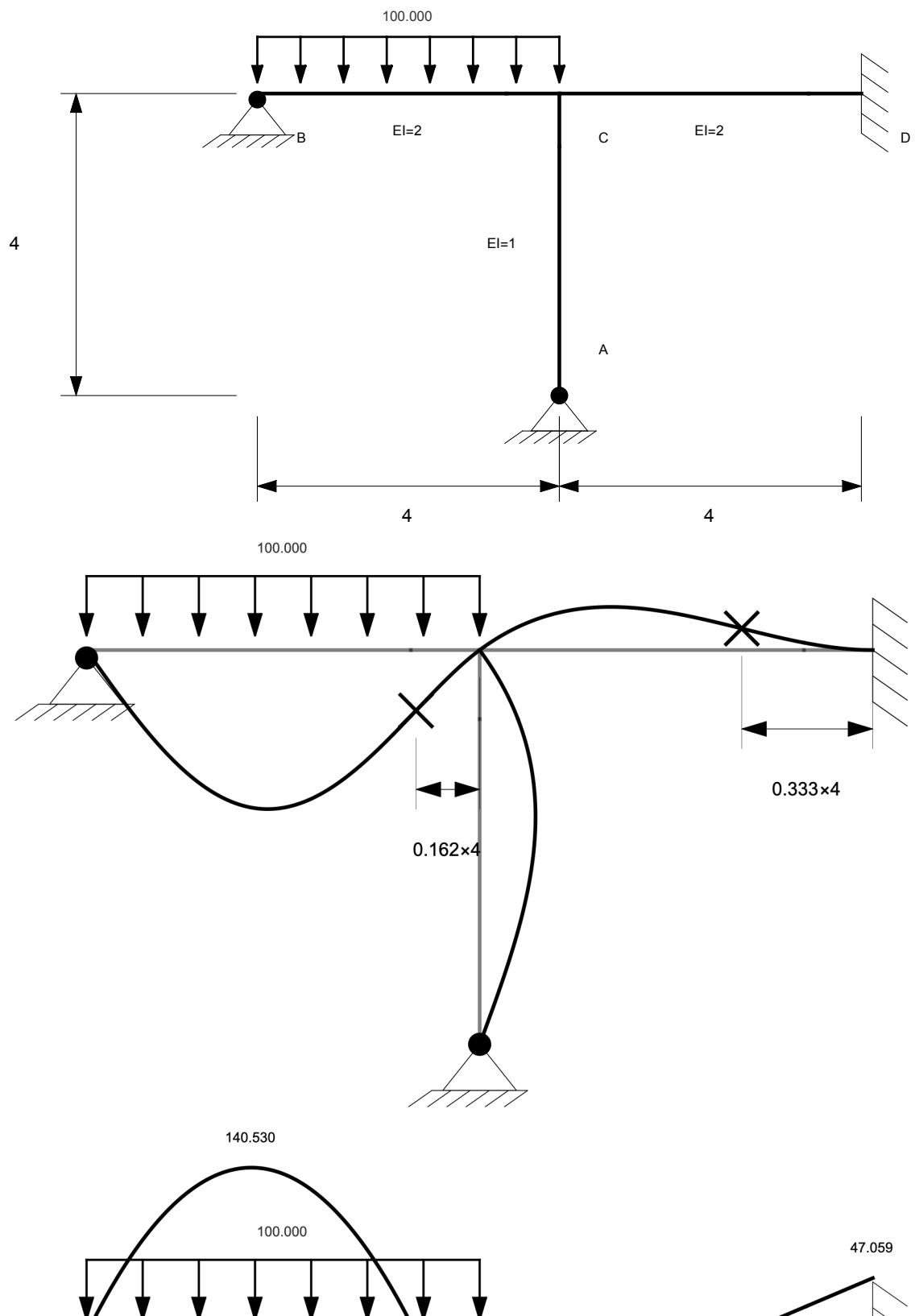
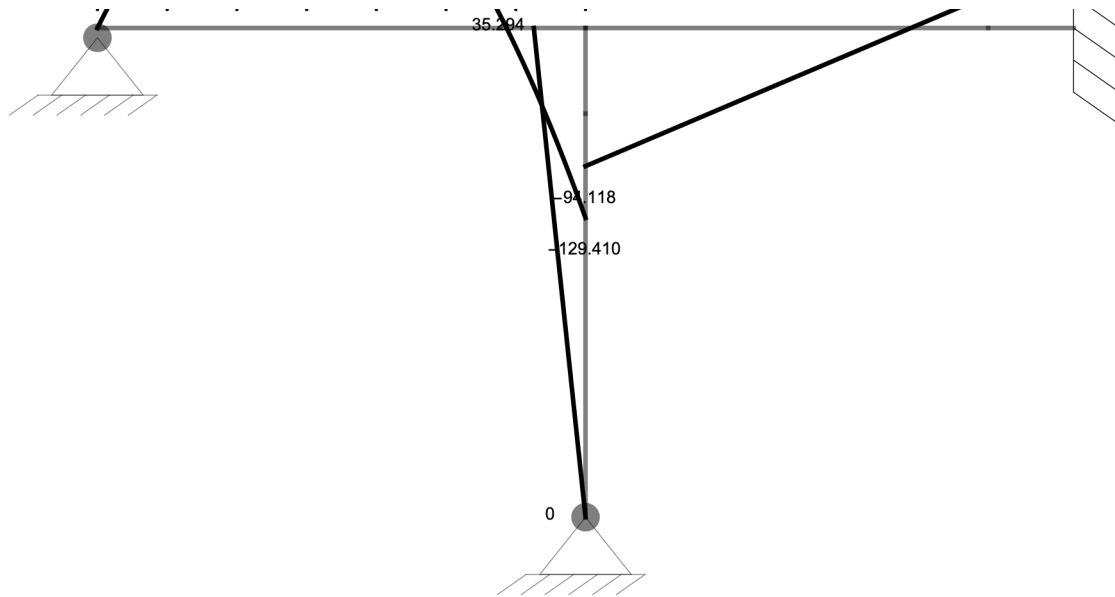


Answers

Q1





Q2

A. This happens because the flanges yield first and once the flanges yield, then all the material in the cross-section has yielded because all the material in an ideal beam is in the flanges and there is no additional reserve capacity.

For the rectangular beam, when the material yields at the top and bottom of the cross-section, the inner part has not yielded and provides additional reserve capacity for yielding so that the moment has to increase in order to yield the rest of the cross-section.

B. If an engineer is prioritizing having large deformations before collapse (called fail-safe design) so that after initial yielding, we get significant deformation with reserve capacity then a rectangular section is preferred. A rectangular section requires twice as much weight for the same load so an intermediate section between an I-beam and a rectangular section may often be preferred.

C. No, for the same cross-sectional area and total height, the I-beam has a higher plastic moment than a rectangular cross-section. Therefore for a beam member with the same weight and height as a rectangular cross-section (or square), the plastic moment of an I-beam cross-section can carry more load before plastic collapse. However, the ratio of plastic moment to the yield moment, which is the plastic shape factor, is higher for a rectangular cross-section.