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In-class Exercise – Week #10: Sectional analysis

The steel girder shown in Figure 1a is made of S355 (nominal yield strength, $f_y = 355MPa$, Young's modulus, $E = 200GPa$) steel plates welded together. The geometry of the cross section is as follows: $b_f = 200mm, t_f = 12mm, d = 300mm, t_w = 10mm$.

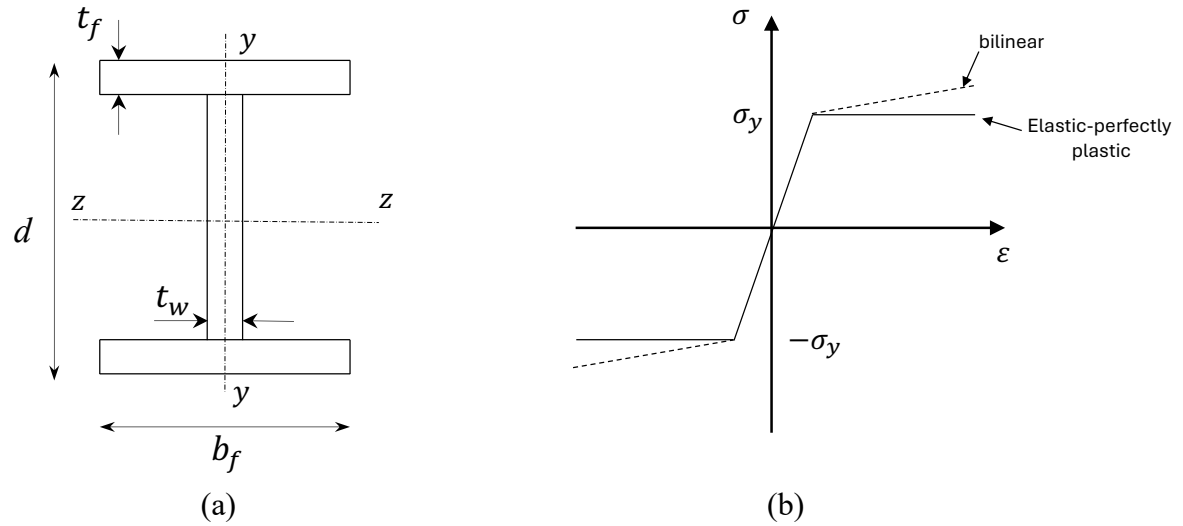

Figure 1. (a) Steel plate girder cross section; (b) stress-strain constitutive formulation

Answer to the following questions:

1. Assume an elastic-perfectly plastic constitutive material law as shown in Figure 1b:

    a. Calculate the yield and plastic bending resistance of the cross section based on structural mechanics and draw the moment-curvature relationship for these two points.

    b. Write a script in Python or MATLAB to discretize the cross section into fiber blocks and to conduct moment curvature analysis for multiple curvature values.

2. Assume a bilinear stress-strain constitutive formulation with a 3% strain hardening ratio as shown in Figure 1b:
    a. Assume the same fiber block discretization of the cross section with that in Question 1-b and conduct a moment curvature analysis for multiple curvature values.
    b. Compare your answer with Questions 1-a and 1-b in the same graph.