CE 327: Singularity Functions With Mathematica
Problems: 10-45 through 10-50

10-30 through 10-32. (a) Determine equations for the elastic curves due to an imposed small vertical displacement Δ of the end for the beams of length L and of constant EI shown in the figures. (b) Plot shear and moment diagrams.

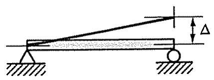

Fig. P10-30

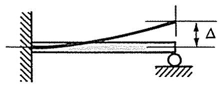

Fig. P10-31

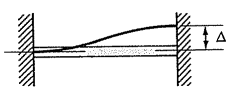

Fig. P10-32

10-33. If in Prob. 10-17, the cross-sectional area of the beam is constant, and the left half of the span is made of steel ($E = 30 \times 10^6$ psi) and the right half is made of aluminum ($E = 10 \times 10^6$ psi), determine the equation of the elastic curve.

10-34. What is the equation of the elastic curve for the cantilever of constant width and flexural strength loaded at the end by a concentrated force P? See Figs. 9-17(a) and (d). Neglect the effect of the required increase in beam depth at the end for shear.

10-35. An overhanging beam of constant flexural rigidity EI is loaded as shown in the figure. For portion AB of the beam, (a) find the equation of the elastic curve due to the applied load of $2w_0$ N/m, and (b) determine the maximum deflection between the supports and the deflection midway between the supports.

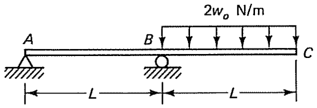

Fig. P10-35

10-36. A beam with an overhang of constant flexural rigidity EI is loaded as shown in the figure. (a) Determine length a of the overhang such that the elastic curve would be horizontal over support B. (B) Determine the maximum deflection between the supports.

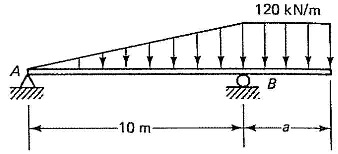

Fig. P10-36

10-37. Using a semigraphical procedure, such as shown in Figs. 10-9 and 10-13, find the deflection of the beam at the point of the applied load; see the figure. Let $I_1 = 400$ in^4, $I_2 = 300$ in^4, and $E = 30 \times 10^6$ psi.

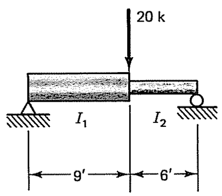

Fig. P10-37

10-38. Using a semigraphical procedure, such as shown in Figs. 10-9 and 10-13, find the deflection at the center of the span for the beam loaded as shown in the figure. Neglect the effect of the axial force on deflection. EI for the beam is constant.

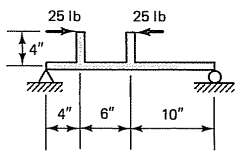

Fig. P10-38

10-39. A steel beam is to span 30 ft and support a 1.2 k/ft uniformly distributed load, including its own weight. Select the required W section of minimum weight, using the abridged Table 4 in the Appendix, for bending around its strong axis. The allowable bending stress is 24 ksi and that for shear is 14.4 ksi. It is also required that the maximum deflection does not exceed 1 in. This requirement corresponds to 1/360-th of the span length and is often used to limit deflection due to the applied load in building design. $E = 29 \times 10^3$ ksi.

10-40. A wooden beam is to span 24 ft and to support a 1 k/ft uniformly distributed load, including its own weight. Select the size required from Table 10 in the Appendix. The allowable bending stress is 2000 psi and that in shear is 100 psi. The deflection is limited to 1/360-th of the span length.

10-41. The maximum deflection for a simple beam spanning 24 ft and carrying a uniformly distributed load of 40 k total, including its own weight, is limited to 0.5 in. (a) Specify the required steel I beam. Let $E = 30 \times 10^6$ psi. (b) What size aluminum-alloy beam would be needed for the same requirements? Let $E = 10 \times 10^6$ psi, and use Table 3 in the Appendix for section properties. (c) Determine the maximum stresses in both cases.

10-42. A uniformly loaded 6 × 12 in (nominal size) wooden beam spans 10 ft and is considered to have satisfactory deflection characteristics. Select an aluminum-alloy I beam, a steel I beam, and a polyester-plastic I beam having the same deflection characteristics. In making the beam selections, neglect the differences in their own weights. Let $E = 1.5 \times 10^6$ psi for wood and polyester plastic, $E = 10 \times 10^6$ psi for aluminum, and $E = 30 \times 10^6$ psi for steel. For section properties of all I beams, use Table 4 in the Appendix.

Section 10-8

10-43. Using singularity functions, rework Prob. 10-19.

10-44. Using singularity functions, rework Prob. 10-29.

10-45 through 10-50. Using singularity functions, obtain equations for the elastic curves for the beams loaded as shown in the figures. EI is constant for all beams.

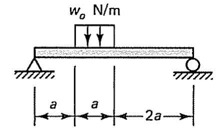

Fig. P10-45

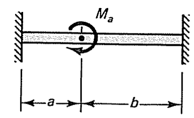

Fig. P10-46

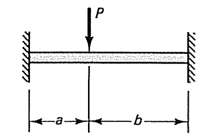

Fig. P10-47

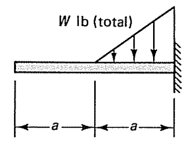

Fig. P10-48

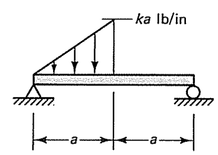

Fig. P10-49

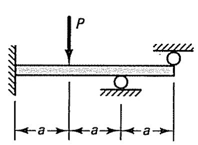

Fig. P10-50

Section 10-9. Use the deflection equations in Examples 10-2 through 10-6 and Table 11 in the Appendix.

10-51. (a) From the solution given in Table 11 in the Appendix for a cantilever loaded by a concentrated