Homework 01 – Deflections

Required:

Using the Virtual Work approach (based on Second Castigliano Theorem), determine deflections, rotations and deformations for the problems listed below (Problems are from Leet, Uang and Gilbert, “Fundamentals of Structural Analysis”, 3rd Edition, 2008):

1) Problem P9.9 (10pts)

P9.9. Compute the slope at A and C and the deflection at B for the beam in Figure P9.9.

![Figure P9.9](image)

2) Problem P9.10 (10 pts)

P9.10. (a) Compute the slope at A and the deflection at midspan in Figure P9.10. (b) If the deflection at midspan is not to exceed 1.2 in, what is the minimum required value of P? E = 29,000 kips/ in².

![Figure P9.10](image)

3) Problem P9.18 (20 pts)

P9.18. Compute the deflection of points B and D in Figure P9.18. The elastomeric pad at C acts as a roller.
4) Problem P10.7  (20 pts)

P10.7. (a) Compute the vertical deflection of joint D produced by the 30-kip load in Figure P10.7. For all bars area = 2 in$^2$ and $E = 9000$ kips/in$^2$, (b) Assume that the truss is unloaded. If bar $AE$ is fabricated in too long, how far to the right must the roller at $B$ be displaced horizontally so that no vertical deflection occurs at joint $D$?

5) Problem P10.24  (20 pts)

P10.24. Compute the horizontal and vertical components of deflection at point $D$ in Figure P10.24. $EI$ is constant, $I = 120$ in$^4$, $E = 29,000$ kips/in$^2$. 
6) Problem P10.30  Include in addition to the loads specified, also a temperature
differential of $\Delta t=40^\circ F$ at the top beam and $\Delta t=0^\circ F$ at the bottom of the beam;
assume that all the construction is made of steel (20 pts)

Notes:

- Solve all problems using the Virtual Work approach and simplified integration;
ignore any request for an alternative method in any of the questions.
- Rotations and slopes are synonyms and should be treated the same.