16-12

A 4 x 10 rectangular Southern pine section is used in a 10-ft cantilever span. Compute the deflections at the quarter points due to a uniform load of 300 lb/ft.

Solution.

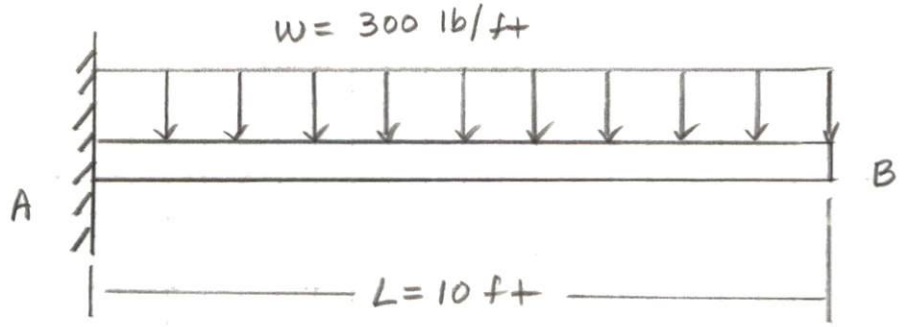

Table A-6(a)

4 in x 10 in $I = 231\ in.^4$

$EI = 1800\ ksi\ (231\ in.^4)$

$= 415\,800\ kip \cdot in^2$

Table A-7(a)

Southern Pine $E = 1800\ ksi$

$L = 10\ ft \left(\frac{12\ in}{ft}\right) = 120\ in.$

$w = 300\ lb/ft \left(\frac{ft}{12\ in}\right)\left(\frac{kip}{1000\ lb}\right) = 0.025\ kip/in$

Table 16-1, case 3

$$\delta = \frac{wx^2}{24EI}\left(x^2 - 4Lx + 6L^2\right) \quad \text{(Deflection Equation)}$$

Calculate δ at the Quarter Points:

x (in)	δ (in)
30	$\frac{0.025\ \frac{kip}{in}(30in)^2\left((30in)^2 - 4(120\ in)(30in) + 6(120in)^2\right)}{24(415\,800\ kip \cdot in^2)} = 0.164\ in$
60	$\frac{0.025\ \frac{kip}{in}(60in)^2\left((60in)^2 - 4(120in)(60in) + 6(120in)^2\right)}{9,979\,200\ kip \cdot in^2} = 0.552\ in.$
90	$\frac{0.025\ \frac{kip}{in}(90in)^2\left((90in)^2 - 4(120in)(90in) + 6(120in)^2\right)}{9,979\,200\ kip \cdot in^2} = 1.041\ in.$
120	$\frac{0.025\ \frac{kip}{in}(120in)^2\left((120in)^2 - 4(120in)(120in) + 6(120in)^2\right)}{9979\,200\ kip \cdot in^2} = \underline{\underline{1.56\ in}}$

$$\delta_{MAX} = \frac{wL^4}{8EI} = \frac{0.025(120)^4}{8(415800)} = 1.56\ in \checkmark$$