Select the lightest W section to carry a uniformly distributed dead load $W_D = 1.0 \text{ k/ft}$ in addition to the beam weight, a uniformly distributed live load $W_L = 2.0 \text{ k/ft}$, and additional concentrated live load of 30 k that may be placed either at midspan between the supports A and B or at point C as shown. Consider all live load placements to produce maximum effects. That is, for the maximum positive moment between supports, live loads should only be placed between supports A and B and left out from the cantilever part BC. On the other hand, for the maximum negative moment, live loads should be placed on the cantilever part BC. Dead loads are always present over the entire beam. The beam is laterally supported. Deflection is not important. Use A572 Grade 50 Steel.
Take section at B

\[ M_B = -48(12) - 3.2(12)^2 + 1.2(12)^2 \]
\[ M_B = -892.8 \text{ k-ft (ultimate)} \]

Negative moment at B is more critical.

Assuming compact section

\[ Z_{\text{required}} = \frac{M_u}{F_y} \]

\[ Z_{\text{required}} = \frac{892.8(12)}{(0.9)50} = 238.1 \text{ in}^3 \]

From p. 3-15 → find W27×84 → \( Z_x = 244 \text{ in}^3 \)

Adding the contribution of weight of beam to \( M_u \)

\[ M_u = 892.8 + 1.2(0.084)12(6) = 900.1 \text{ k-ft} \]

\( \Phi M_n = \Phi M_p = 915 \text{ k-ft} > 900.1 \text{ k-ft} \) OK

Use W27×84 Grade 50 Steel

Note that W27×84 is compact since Table 3-2 on p. 3-15 does not indicate otherwise.