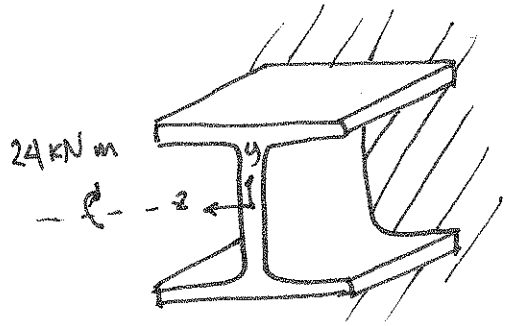
11.29a. SOLUTION



24 kN·m is applied to a W200 x 46.1 beam. Find σ_{max}, radius of curvature. $E = 200$ GPa.

FBD:

$M_{App.}$ ↺ [A] ↻ M_{wall} (shear, tension at wall = 0)

$\{\Sigma \vec{M}_{/A} = 0\}\cdot\hat{x} \Rightarrow M_{wall} - M_{App} = 0 \Rightarrow \underline{M_{wall} = M_{App}}$.

so it is in pure bending.

$\sigma_{max} = -\frac{Mc}{I_z}$ (Eqn 11.15 : max σ is at farthest distance from neutral axis)

From Appendix B: $I_x = 45.8 \cdot 10^6\ mm^4$ (their x-axis is our z-axis)

$d = 203$ mm (height of beam)

so $\sigma_{max} = -\frac{(24\ kN\cdot m)\left(\pm\frac{.203\ m}{2}\right)}{(45.8\cdot 10^6\ mm^4)\left(\frac{10^{-12}\ m^4}{mm^4}\right)} = \boxed{\pm 53.2\ MPa}$

(neutral axis is at center for symmetric shapes)

$\rho = \frac{EI_z}{M}$ (Eqn 11.21)

so $\rho = \frac{(200\ GPa)(45.8\cdot 10^6\ mm^4)\left(\frac{10^{-12}\ m^4}{mm^4}\right)}{24\ kN\cdot m} = \boxed{382\ m}$