Top Rail Calculations

Material Info: Steel Pipe ASTM A53 $F_y := 35 \cdot ksi$ $F_u := 60 \cdot ksi$ $E := 29000 \cdot ksi$

$rail_{info} = ?$

Max Span = $L := 4\ ft$

Load Requirments:
Uniform Load = $w := 50\ plf$
Concentrated = $P := 200\ lb$

Load requirments based on ASCE 7-10 section 4.5.1

	Uniform Loading	Concentrated Loading
$V_0 := P = 200\ lb$	$V_1 := \frac{w \cdot L}{2} = 100\ lb$	$V_2 := \frac{P}{2} = 100\ lb$
	$M_1 := \frac{w \cdot L^2}{8} = 100\ lb \cdot ft$	$M_2 := \frac{P \cdot L}{4} = 200\ lb \cdot ft$
	$\Delta_1 := \frac{5 \cdot w \cdot L^4}{384 \cdot E \cdot I_{rail}} = ?\ in$	$\Delta_2 := \frac{P \cdot L^3}{48 \cdot E \cdot I_{rail}} = ?\ in$

Deflection, Moment, and Shear is based on Table 3-23
Uniform Loading based on Case 1
Concentrated Loading based on Case 7&8
Vo based on point load at support

Moment of inertia if the rail is $I_{rail} = ?\ in^4$

$V_{max} = 200\ lb$ $M_{max} = 200\ lb \cdot ft$ $\Delta_{max} = ?\ in$

Check member for shear:
Spec. Chapter G, section G6

$$F_{cr_1} := \frac{1.6 \cdot E}{\sqrt{\frac{L_v}{outdiameter_{rail}}} \cdot \left(\frac{outdiameter_{rail}}{thickness_{rail}}\right)^{\frac{5}{4}}} = ?\ \frac{lb}{in^2}$$

Lv = distance from max shear to zero shear; $L_v := \frac{L}{2} = 2\ ft$

$$F_{cr_2} := \frac{0.78 \cdot E}{\left(\frac{outdiameter_{rail}}{thickness_{rail}}\right)^{\frac{3}{2}}} = ?\ \frac{lb}{in^2}$$

Fcr shall be the larger of Fcr1 and Fcr2 but shall not exceed $0.6 \cdot F_y = 21000\ \frac{lb}{in^2}$

$F_{cr} = ?\ \frac{lb}{in^2}$

$V_n := \frac{F_{cr} \cdot area_{rail}}{2} = ?$ $V_n \geq 1.6 \cdot V_{max} = ?$

Vn is greater then or equal to 1.6*Vmax therefor Pipe 1-1/4STD is ok in shear.

Check member in flexure:
Spec. Chapter F, section F8

$\frac{outdiameter_{rail}}{thickness_{rail}} < \frac{0.45 \cdot E}{F_y} = ?$ Ratio shall be 1 for section to apply

$\frac{outdiameter_{rail}}{thickness_{rail}} < \frac{0.07 \cdot E}{F_y} = ?$ If 1 compact; If 0 refer below

$\frac{outdiameter_{rail}}{thickness_{rail}} < \frac{0.31 \cdot E}{F_y} = ?$ If above is 1 ignore. If above is 0 then 1=noncompact, 0=slender

$M_p := F_y \cdot Z_{rail} = ?$ Since member is compact Local Buckling does not apply

$M_{allow_0} := M_p = ?$

$M_{allow_0} \geq 1.6 \cdot M_{max} = ?$

Mallow is greater then or equal to 1.6*Mmax therefor Pipe 1-1/4STD is ok in flexure.