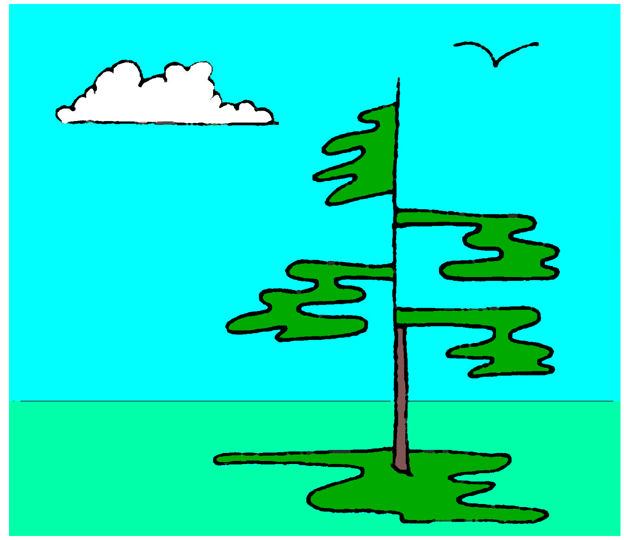
NorthWoods Software



Program Name: Jib_Crane_Extension

Project Name: -

Project Number: -

Project Description: -

Project Designer: Dik

Last Revised (yy-mm-dd): 21.08.11

Reference: NBCC, CSA S16

Created using SMath Studio, a MathCAD workalike from https://en.smath.info/view/SMathStudio. The User is responsible to verify data using an alternative method

Menu:

....	Input Data	....	Important Output	....	Logical Constructs	**Blue**	**Units**
....	Sum / For	**Red**	**Important Note**	**Gray**	**Temporary Variables**		

Defined Units:

$K := kip$ — Force

$K\_ft := K\ ft$ $\quad kN\_m := kN\ m$ $\quad K\_in := K\ in$ $\quad kN\_mm := kN\ mm$ $\quad lb\_in := lbf\ in$ — Moment

$pcf := \frac{lbf}{ft^3}$ $\quad kNpcm := \frac{kN}{m^3}$ $\quad kgpcm := \frac{kg}{m^3}$ — Density

$Klf := \frac{K}{ft}$ $\quad plf := \frac{lbf}{ft}$ $\quad kNpm := \frac{kN}{m}$ $\quad Kpi := \frac{K}{in}$ $\quad kNpmm := \frac{kN}{mm}$ — Force/Unit Length

$psf := \frac{lbf}{ft^2}$ $\quad Ksf := \frac{K}{ft^2}$ $\quad Ksi := \frac{K}{in^2}$ $\quad kNpsm := \frac{kN}{m^2}$ $\quad psi := \frac{lbf}{in^2}$ — Pressure

$Npsmm := \frac{N}{mm^2}$ — Pressure

$pci := \frac{lbf}{in^3}$ — Subgrade Modulus

$psfpf := \frac{psf}{ft}$ $\quad kPapm := \frac{kPa}{m}$ — Pressure per Depth

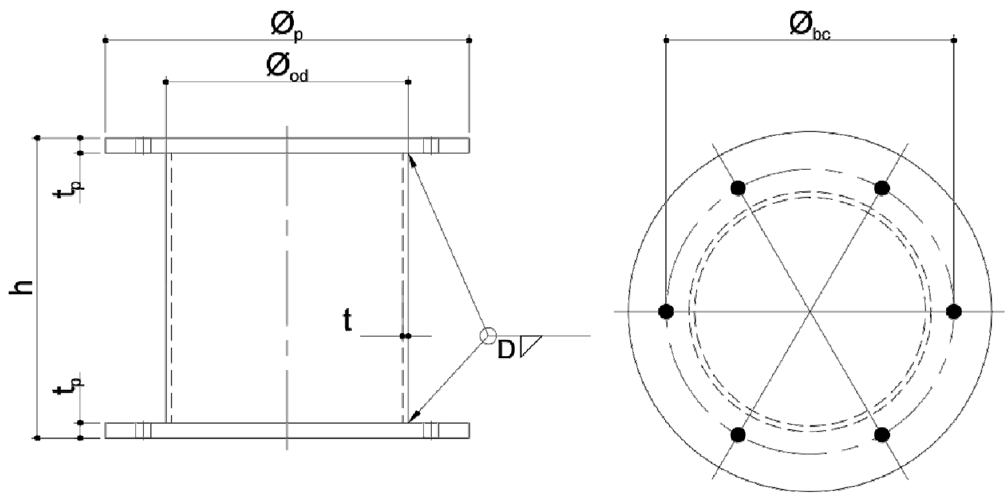
$pmcf := \frac{lb}{ft^3}$ $\quad lb := lbf$ — Force

$mph := \frac{mi}{hr}$ $\quad kph := \frac{km}{hr}$ — Velocity

$ispf := \frac{in^2}{ft}$ $\quad mmspm := \frac{mm^2}{m}$ — Area per Unit Length

c b a

Input Data



Material Property Factors:

$\varphi_s := 0.90$ Rolled Sections

$\varphi_b := 0.8$ Bolts

$\varphi_w := 0.67$ Weld

$\varphi_{br} := 0.8$ Bolts Bearing

$\varphi_u := 0.75$ Block Shear

Load Factors:

$\alpha_L := 1.50$

$\alpha_{D1} := 1.25$

$\alpha_{D2} := 0.85$

Steel Properties:

HSS Section: $st_{NDX} := 1$

$st :=$

NDX	des	fy	Fu
1	"G40.21-350W"	50 Ksi	65 Ksi
2	"G40.21-300W"	44 Ksi	65 Ksi
3	"A36"	36 Ksi	58 Ksi

$desM_{st1} := st_{st_{NDX}\ 2}$ $f_{y1} := st_{st_{NDX}\ 3}$ $F_{u1} := st_{st_{NDX}\ 4}$

$G_s := \frac{E_s}{2 \cdot (1 + \nu)}$ $\gamma_s := 489\ pcf$ $\nu := 0.3$ $E_s := 29000\ Ksi$

Base Plate: $st_{NDX} := 2$ $desM_{st2} := st_{st_{NDX}\ 2}$ $f_{y2} := st_{st_{NDX}\ 3}$ $F_{u2} := st_{st_{NDX}\ 4}$

Weld Design:

Weld Sizes: $ws_{NDX} := 12$

$ws :=$

NDX	desI	desM	D
1	""	"3mm"	0.11811 in
2	"1/8"	""	0.125 in
3	""	"4mm"	0.15748 in
4	"3/16"	""	0.1875 in
5	""	"5mm"	0.19685 in
6	""	"6mm"	0.23622 in
7	"1/4"	""	0.25 in
8	""	"7mm"	0.275591 in
9	"5/16"	""	0.3125 in
10	""	"8mm"	0.314961 in
11	""	"9mm"	0.354331 in
12	"3/8"	""	0.375 in
13	""	"10mm"	0.3937 in
14	""	"11mm"	0.4331 in
15	"7/16"	""	0.4375 in
16	""	"12mm"	0.4724 in
17	"1/2"	""	0.50 in

$desI_D := ws_{ws_{NDX}\ 2}$ $desM_D := ws_{ws_{NDX}\ 3}$ $D := ws_{ws_{NDX}\ 4}$

Weld Electrodes: $we_{NDX} := 2$

$we :=$

NDX	DesI	DesM	UTS
1	"E60xx"	"E43xx"	60 ksi
2	"E70xx"	"E49xx"	70 ksi
3	"E80xx"	"E55xx-x"	80 ksi
4	"E90xx"	"E62xx-x"	90 ksi

$desI_w := we_{we_{NDX}\ 2}$ $desM_w := we_{we_{NDX}\ 3}$ $X_u := we_{we_{NDX}\ 4}$

Dimension Properties:

	c	b	a
$\phi_p := 24\ in$	$\phi_p = 24.0\ in$	$\phi_p = 609.6\ mm$	Base Plate Diameter
$\phi_{bc} := 20\ in$	$\phi_{bc} = 20.0\ in$	$\phi_{bc} = 508\ mm$	Bolt Circle Diameter
$t_p := 1.00\ in$	$t_p = 1.000\ in$	$t_p = 25.4\ mm$	Base Plate Thickness
$\phi_{od} := 16\ in$	$\phi_{od} = 16.0\ in$	$\phi_{od} = 406.4\ mm$	HSS Tube Outside Diameter
$t := 0.375\ in$	$t = 0.4\ in$	$t = 9.5\ mm$	HSS Tube Thickness
$r_{od} := \frac{\phi_{od}}{2}$	$r_{od} = 8.0\ in$	$r_{od} = 203.2\ mm$	HSS Tube Radius
$\phi_{id} := \phi_{od} - 2 \cdot t$	$\phi_{id} = 15.3\ in$	$\phi_{id} = 387.4\ mm$	HSS Tube Outside Diameter
$Sx := \pi \cdot \left(\frac{\phi_{od}^4 - \phi_{id}^4}{32 \cdot \phi_{od}} \right)$	$Sx = 70.26\ in^3$	$Sx = 1.15 \cdot 10^6\ mm^3$	HSS Section Modulus
$Zx := \frac{\phi_{od}^3 - \phi_{id}^3}{6}$	$Zx = 91.57\ in^3$	$Zx = 1.50 \cdot 10^6\ mm^3$	HSS Plastic Section
$Ix := \pi \cdot \left(\frac{\phi_{od}^4 - \phi_{id}^4}{64} \right)$	$Ix = 562.08\ in^4$	$Ix = 2.34 \cdot 10^8\ mm^4$	HSS Moment of Inertia

Class of Section:

```
if φod/t ≤ 13000 MPa / fy1
    Class := 1
else
    if φod/t ≤ 18000 MPa / fy1
        Class := 2
    else
        if φod/t ≤ 66000 MPa / fy1
            Class := 3
        else
            Class := 4
```

$Class = 2$ — Class of HSS Section

```
if (Class = 1) ∨ (Class = 2)
    Mr := φs · fy1 · Zx
else
    Mr := φs · fy1 · Sx
```

$M_r = 343.39\ K\_ft$ — $M_r = 465.57\ kN\_m$ — Moment Resistance of HSS Section

Anchor Rod Properties:

$F_{ub} := 60\ Ksi$	$F_{ub} = 60\ Ksi$	$F_{ub} = 414\ MPa$	Ultimate Strength of Anchor Rod
$\phi_b := 1\ in$	$\phi_b = 1.000\ in$	$\phi_b = 25.4\ mm$	Diameter of Anchor Rod
$l_b := 36\ in$	$l_b = 36.0\ in$	$l_b = 914.4\ mm$	Length of Anchor Rod
$l_e := 30\ in$	$l_e = 30.0\ in$	$l_e = 762\ mm$	Embedded Length of Anchor Rod
$N_b := 6$	$N_b = 6$		Total Number of Anchor Rods
$l_x := l_b - l_e$	$l_x = 6.0\ in$	$l_x = 152.4\ mm$	Extended Length of Anchor Rod
$A_b := \frac{\pi \cdot \phi_b^2}{4}$	$A_b = 0.79\ in^2$	$A_b = 506.71\ mm^2$	Area of Anchor Rod

Service Design Loads:

$M_{sD} := 0\ K\_ft$	$M_{sD} = 0.0\ K\_ft$	$M_{sD} = 0\ kN\_m$	Moment Service Dead Load
$M_{sL} := 12.5\ K\_ft$	$M_{sL} = 12.5\ K\_ft$	$M_{sL} = 16.9\ kN\_m$	Moment Service Live Load
$V_{sD} := 0\ K$	$V_{sD} = 0.0\ K$	$V_{sD} = 0\ kN$	Shear Service Live Load
$V_{sL} := 1\ K$	$V_{sL} = 1.0\ K$	$V_{sL} = 4.4\ kN$	Shear Service Live Load
$P_{sD} := (0)\ K$	$P_{sD} = 0.0\ K$	$P_{sD} = 0\ kN$	Axial Service Load
$P_{sL} := (-1.3)\ K$	$P_{sL} = -1.3\ K$	$P_{sL} = -5.8\ kN$	Axial Service Load

Factored Design Loads:

$M_f := M_{sD} \cdot \alpha_{D1} + M_{sL} \cdot \alpha_L$	$M_f = 18.8\ K\_ft$	$M_f = 25.4\ kN\_m$	Factored Moment
$V_f := V_{sD} \cdot \alpha_{D1} + V_{sL} \cdot \alpha_L$	$V_f = 1.5\ K$	$V_f = 6.7\ kN$	Factored Shear
$P_{f1} := P_{sD} \cdot \alpha_{D1} + P_{sL} \cdot \alpha_L$	$P_{f1} = -2.0\ K$	$P_{f1} = -8.7\ kN$	Factored Max Tension
$P_{f2} := P_{sD} \cdot \alpha_{D2} + P_{sL} \cdot \alpha_L$	$P_{f2} = -2.0\ K$	$P_{f2} = -8.7\ kN$	Factored Min Tension

Factored Design Load Override:

$M'_f := 12.5\ K\_ft$

if $M'_f = 0\ K\_ft$
$\quad M_f := M_f$
else
$\quad M_f := M'_f$

$M_f = 12.5\ K\_ft$ | $M_f = 16.9\ kN\_m$ | Design Factored Moment

$V'_f := 1\ K$

if $V'_f = 0\ K$
$\quad V_f := V_f$
else
$\quad V_f := V'_f$

$V_f = 1.0\ K$ | $V_f = 4.4\ kN$ | Design Factored Shear

$P'_{f1} := (-1)\ K$

if $P'_{f1} = 0\ K$
$\quad P_{f1} := P_{f1}$
else
$\quad P_{f1} := P'_{f1}$

$P_{f1} = -1.0\ K$ | $P_{f1} = -4.4\ kN$ | Designed Factored Max Tension

$P'_{f2} := (0-1)\ K$

if $P'_{f2} = 0\ K$
$\quad P_{f2} := P_{f2}$
else
$\quad P_{f2} := P'_{f2}$

$P_{f2} = -1.0\ K$ | $P_{f2} = -4.4\ kN$ | Design Factored Min Tension

Moment Resistance of HSS Section (Roark, Table 15.2 16):

$K := 0.72$

if $\frac{r_{od}}{t} > 10$
$$M'_r := K \cdot \frac{E_s}{1-\nu^2} \cdot r_{od} \cdot t^2$$
else
$\quad M'_r := M_r$

$M'_r = 2151\ K\_ft$ | $M'_r = 2916\ kN\_m$ | Max Mr based on Roark

Moment Resistance of HSS Section (ISO 19902.07):

$\sigma_b := f_{y1} \cdot \varphi_s$ | $\sigma_b = 45.0$ Ksi | $\sigma_b = 310.3$ MPa | Resistant Flexural Yield Strength

```
if (f_y1·ϕ_od)/(E_s·t) ≤ 0.0517
  f_b := φ_s·σ_b
else
  if (f_y1·ϕ_od)/(E_s·t) ≤ 0.1034
    f_b := (1.13 − (2.58·f_y1·ϕ_od)/(E_s·t))·(Zx/Sx)·φ_s·f_y1
  else
    if (f_y1·ϕ_od)/(E_s·t) ≤ 120·(f_y1/E_s)
      f_b := (0.94 − (0.76·f_y1·ϕ_od)/(E_s·t))·(Zx/Sx)·φ_s·f_y1
    else
      f_b := 0 Ksi
```

$f_b = 55.1$ Ksi | $f_b = 380.2$ MPa

$M_{rISO} := f_b \cdot Sx$ | $M_{rISO} = 323$ K_ft | $M_{rISO} = 438$ kN_m | Max Mr based on ISO

$M_{rs} := \min\left(\left[\, M_r \;\; M'_r \;\; M_{rISO} \,\right]\right)$ | $M_{rs} = 323$ K_ft | $M_{rs} = 438$ kN_m | Maximum Moment Resistance

Bolt Circle Properties:

$y_o := \dfrac{\phi_{bc}}{2}$ | $y_o = 10$ in | $y_o = 254$ mm

$\Delta_\phi := \dfrac{360\ °}{N_b}$ | $\Delta_\phi = 60.00\ °$

```
for n ∈ [1..N_b]
  ϕ_n := (n − 1)·Δ_ϕ
  y_n := y_o·cos(ϕ_n)
  I_n := (y_o·cos(ϕ_n))^2
```

$I_{tot} := \sum I$ | $I_{tot} = 300\ in^2$ | $I_{tot} = 1.94 \cdot 10^5\ mm^2$ | Bolt Circle Moment of Inertia

Combined Forces:

$F_{fc} := \left(\dfrac{P_{f1}}{N_b} - \dfrac{M_f \cdot y_o}{I_{tot}}\right)$ | $F_{fc} = -5.17$ K | $F_{fc} = -23.0$ kN

$F_{ft} := \dfrac{P_{f2}}{N_b} + \dfrac{M_f \cdot y_o}{I_{tot}}$ | $F_{ft} = 4.83$ K | $F_{ft} = 21.5$ kN

$F_f := \max\left(\left[\, F_{fc} \;\; F_{ft} \,\right]\right)$ | $F_f = 4.83$ K | $F_f = 21.5$ kN | Factored Max Bolt Tension

$F_{fv} := \dfrac{V_f}{N_b}$ | $F_{fv} = 0.17$ K | $F_{fv} = 0.7$ kN | Factored Max Bolt Shear

Design of Anchor Rod:

$T_r := \varphi_b \cdot 0.75 \cdot A_b \cdot F_{ub}$	$T_r = 28.27$ K	$T_r = 125.77$ kN	Resistant Bolt Tension
$V_r := 0.7 \cdot \left(0.6 \cdot \varphi_b \cdot A_b \cdot F_{ub}\right)$	$V_r = 15.83$ K	$V_r = 70.43$ kN	Resistant Bolt Shear
$cs := \left(\frac{F_{fv}}{V_r}\right)^2 + \left(\frac{F_f}{T_r}\right)^2$	$cs = 0.03$		Combined Stresses

Length of Anchor Rod:

$l_r := 24 \cdot \phi_b$	$l_r = 24.00$ in	$l_r = 609.60$ mm	Minimum Length of Anchor Rod

Base Plate:

$Cir := \frac{\pi \cdot \phi_{od}}{N_b}$	$Cir = 8.38$ in	$Cir = 213$ mm	
$Z_p := Cir \cdot \frac{t_p^{\ 2}}{4}$	$Z_p = 2.1\ in^3$	$Z_p = 34321\ mm^3$	Bolt Circle Plastic Modulus
$M_{rp} := \varphi_s \cdot f_{y2} \cdot Z_p$	$M_{rp} = 82.9$ K_in	$M_{rp} = 9.4$ kN_m	Moment Resistance of Bolt Circle
$M_{fp} := F_f \cdot \left(\frac{\phi_{bc} - \phi_{od}}{2}\right)$	$M_{fp} = 9.7$ K_in	$M_{fp} = 1.1$ kN_m	Factored Moment at Bolt Circle

Weld Design:

Weld Material Strength:

$v_{rw} := \varphi_w \cdot 0.67 \cdot X_u \cdot \frac{1}{\sqrt{2}}$	$v_{rw} = 22.2$ ksi	$v_{rw} = 153.2$ MPa	Weld Material Strength

HSS Metal Strength:

$v_{rb1} := \varphi_w \cdot 0.67 \cdot F_{u1}$	$v_{rb1} = 29.2$ Ksi	$v_{rb1} = 201.2$ MPa	HSS Material Strength

Base Plate Strength:

$v_{rb1} := \varphi_w \cdot 0.67 \cdot F_{u1}$	$v_{rb1} = 29.2$ Ksi	$v_{rb1} = 201.2$ MPa	Base Plate Material Strength

Minimum Weld Capacity:

$V_{rw} := \min\left(\left[\, v_{rw}\ \ v_{rb1} \,\right]\right)$	$V_{rw} = 22.2$ Ksi	$V_{rw} = 153.2$ MPa	Strength of Weld

Minimum Fillet Weld Size based on Material Thickness:

$t_{conn} := \max\left(\left[\, t\ \ t_p \,\right]\right)$

```
if  t_conn < 0.25 in
  D_min := .125 in
else
  if  t_conn ≤ 0.50 in
    D_min := 0.1875 in
  else
    if  t_conn ≤ 0.75 in
      D_min := 0.250 in
    else
      D_min := 0.3125 in
```

$D_{min} = 0.3125$ in	$D_{min} = 7.94$ mm	Minimum Weld Size

Section Properties of Weld:

$$A_w := \frac{\pi \cdot \left(\left(\phi_{od} + D \right)^2 - \phi_{od}^2 \right)}{4}$$

Area of Weld

$A_w = 9.54\ in^2$ $A_w = 6151.75\ mm^2$

$$Sx_w := \frac{\pi \cdot \left(\left(\phi_{od} + D \right)^4 - \phi_{od}^4 \right)}{32 \cdot \left(\phi_{od} + D \right)}$$

Section Modulus of Weld

$Sx_w = 38.15\ in^3$ $Sx_w = 6.25 \cdot 10^5\ mm^3$

$$\sigma_f := \frac{M_f}{Sx_w}$$

$\sigma_f = 3.93\ Ksi$ $\sigma_f = 27.11\ MPa$

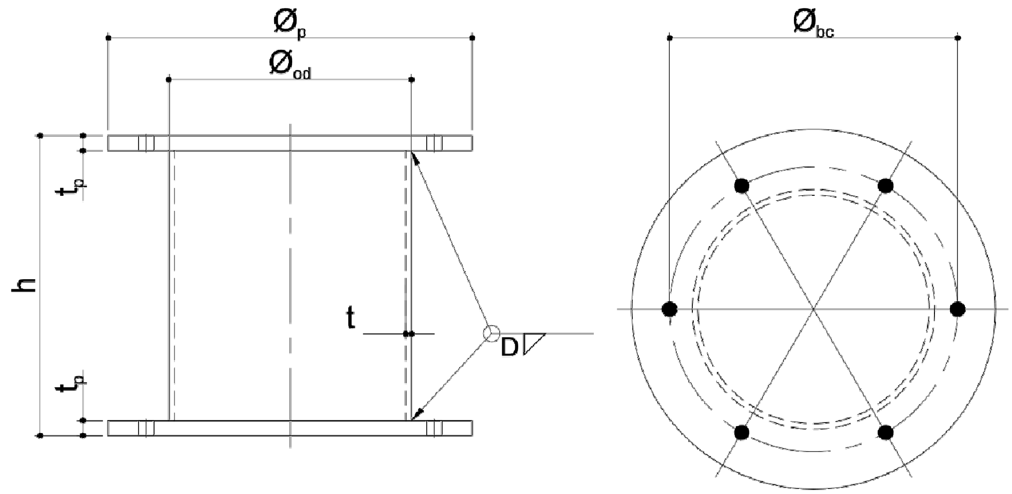
$$\sigma_v := \frac{V_f}{A_w}$$

$\sigma_v = 0.10\ Ksi$ $\sigma_v = 0.72\ MPa$

$$\sigma_c := \sqrt{\sigma_f^2 + \sigma_v^2}$$

$\sigma_c = 3.93\ Ksi$ $\sigma_c = 27.12\ MPa$ Combined Stress of Weld

Summary:



Material Property Factor

$\varphi_s = 0.90$	Rolled Sections
$\varphi_b = 0.80$	Bolts
$\varphi_w = 0.67$	Weld
$\varphi_{br} = 0.80$	Bolts Bearing
$\varphi_u = 0.75$	Block Shear

Dead Load Factor $\alpha_{D1} = 1.25$

Dead Load Factor $\alpha_{D2} = 0.85$

Live Load Factor $\alpha_L = 1.5$

$Check\left(\alpha_L \geq 1.5\right) = \text{"...OK"}$

Steel Properties

HSS Section

Designation	$desM_{st1} = \text{"G40.21-350W"}$	
Yield Strength	$f_{y1} = 50\ \text{Ksi}$	$f_{y1} = 345\ \text{MPa}$
Ultimate Strength	$F_{u1} = 65\ \text{Ksi}$	$F_{u1} = 448\ \text{MPa}$

Base Plate

Designation	$desM_{st2} = \text{"G40.21-300W"}$	
Yield Strength	$f_{y2} = 44\ \text{Ksi}$	$f_{y2} = 303\ \text{MPa}$
Ultimate Strength	$F_{u2} = 65\ \text{Ksi}$	$F_{u2} = 448\ \text{MPa}$
Young's Modulus	$E_s = 29000\ \text{Ksi}$	$E_s = 1.9995 \cdot 10^5\ \text{MPa}$
Shear Modulus	$G_s = 11153.8462\ \text{Ksi}$	$G_s = 76903\ \text{MPa}$
Density	$\gamma_s = 489\ \text{pcf}$	$\gamma_s = 76.8\ \text{kNpcm}$

Welding

Electrode Designation	$desI_w = \text{"E70xx"}$	$desM_w = \text{"E49xx"}$
Ultimate Strength	$X_u = 70\ \text{ksi}$	$X_u = 483\ \text{MPa}$
Weld Size Designation	$desI_D = \text{"3/8"}$	$desM_D = \text{""}$
Weld Size	$D = 0.3750\ \text{in}$	$D = 9.5\ \text{mm}$
Minimum Weld Size	$D_{min} = 0.3125\ \text{in}$	$D_{min} = 7.9\ \text{mm}$
Strength of Weld	$V_{rw} = 22.2\ \text{Ksi}$	$V_{rw} = 153.2\ \text{MPa}$

HSS and Base Plate Properties

Base Plate Diameter	$\phi_p = 24.0\ \text{in}$	$\phi_p = 609.6\ \text{mm}$
Bolt Circle Diameter	$\phi_{bc} = 20.0\ \text{in}$	$\phi_{bc} = 508\ \text{mm}$
Base Plate Thickness	$t_p = 1.000\ \text{in}$	$t_p = 25.4\ \text{mm}$
HSS Tube Outside Diameter	$\phi_{od} = 16.0\ \text{in}$	$\phi_{od} = 406.4\ \text{mm}$
HSS Tube Thickness	$t = 0.4\ \text{in}$	$t = 9.5\ \text{mm}$
HSS Tube Outside Diameter	$\phi_{id} = 15.3\ \text{in}$	$\phi_{id} = 387.4\ \text{mm}$
HSS Section Modulus	$Sx = 70.26\ \text{in}^3$	$Sx = 1.15 \cdot 10^6\ \text{mm}^3$
HSS Plastic Section	$Zx = 91.57\ \text{in}^3$	$Zx = 1.50 \cdot 10^6\ \text{mm}^3$

HSS Moment of Inertia	$Ix = 562.08\ in^4$	$Ix = 2.34 \cdot 10^8\ mm^4$
Class of HSS Section	$Class = 2$	
Ultimate Strength of Anchor Rod	$F_{ub} = 60\ Ksi$	$F_{ub} = 414\ MPa$
Diameter of Anchor Rod	$\phi_b = 1.000\ in$	$\phi_b = 25.4\ mm$
Length of Anchor Rod	$l_b = 36.0\ in$	$l_b = 914.4\ mm$
Embedded Length of Anchor Rod	$l_e = 30.0\ in$	$l_e = 762\ mm$
Total Number of Anchor Rods	$N_b = 6$	
Extended Length of Anchor Rod	$l_x = 6.0\ in$	$l_x = 152.4\ mm$
Area of Anchor Rod	$A_b = 0.79\ in^2$	$A_b = 506.71\ mm^2$

Factored Design Loads

Design Factored Moment	$M_f = 12.5\ K\_ft$	$M_f = 16.9\ kN\_m$
Design Factored Shear	$V_f = 1.0\ K$	$V_f = 4.4\ kN$
Designed Factored Max Tension	$P_{f1} = -1.0\ K$	$P_{f1} = -4.4\ kN$
Design Factored Min Tension	$P_{f2} = -1.0\ K$	$P_{f2} = -4.4\ kN$

Moment Resistance of HSS Section

Based on Section Properties	$M_r = 343.39\ K\_ft$	$M_r = 465.57\ kN\_m$
Based on Stability (Roark)	$M'_r = 2151\ K\_ft$	$M'_r = 2916\ kN\_m$
Based on Stability (ISO)	$M_{rISO} = 323\ K\_ft$	$M_{rISO} = 438\ kN\_m$
Maximum Moment Resistance	$M_{rs} = 323\ K\_ft$	$M_{rs} = 438\ kN\_m$

$Check\left(M_{rs} \geq M_f\right) = "...OK"$ $Check\left(\dfrac{M_{rs}}{\varphi_s} \geq M_f\right) = "...OK"$ **Allow for Overload**

Bolt Circle Properties:

Bolt Circle Moment of Inertia	$I_{tot} = 300\ in^2$	$I_{tot} = 1.94 \cdot 10^5\ mm^2$
Factored Max Bolt Tension	$F_f = 4.83\ K$	$F_f = 21.5\ kN$
Factored Max Bolt Shear	$F_{fv} = 0.17\ K$	$F_{fv} = 0.7\ kN$
Resistant Bolt Tension	$T_r = 28.27\ K$	$T_r = 125.77\ kN$
Resistant Bolt Shear	$V_r = 15.83\ K$	$V_r = 70.43\ kN$
Combined Stresses	$cs = 0.03$	

$Check\left(cs \leq 1.0\right) = "...OK"$

Minimum Length of Anchor Rod	$l_r = 24.00\ in$	$l_r = 609.60\ mm$

$Check\left(l_e \geq l_r\right) = "...OK"$

Bolt Circle Plastic Modulus	$Z_p = 2.1\ in^3$	$Z_p = 34321\ mm^3$
Moment Resistance of Bolt Circle	$M_{rp} = 82.9\ K\_in$	$M_{rp} = 9.4\ kN\_m$
Factored Moment at Bolt Circle	$M_{fp} = 9.7\ K\_in$	$M_{fp} = 1.1\ kN\_m$

$Check\left(M_{rp} \geq M_{fp}\right) = "...OK"$ $Check\left(\dfrac{M_{rp}}{\varphi_s} \geq M_{fp}\right) = "...OK"$ **Allow for Overload**

Section Properties of Weld

Area of Weld $A_w = 9.54\ in^2$ $A_w = 6151.75\ mm^2$

Section Modulus of Weld $Sx_w = 38.15\ in^3$ $Sx_w = 6.25 \cdot 10^5\ mm^3$

Combined Stress of Weld $\sigma_c = 3.93\ Ksi$ $\sigma_c = 27.12\ MPa$

$Check\left(V_{rw} \ge \sigma_c\right) = "...OK"$ $Check\left(\frac{V_{rw}}{\varphi_s} \ge \sigma_c\right) = "...OK"$ **Allow for Overload**