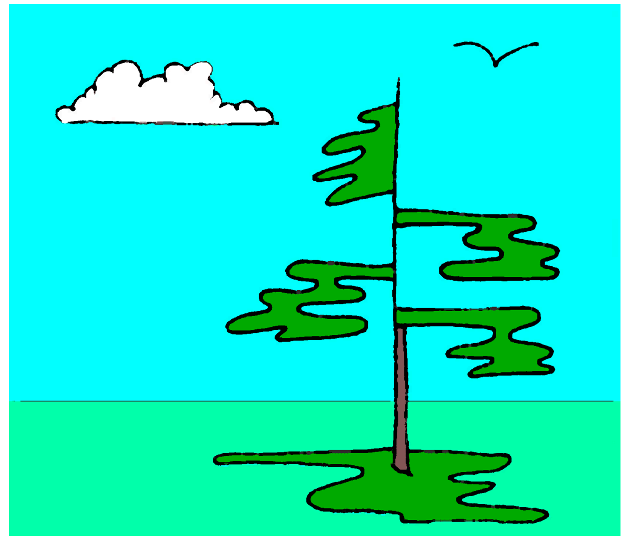
NorthWoods Software



Program Name: Weld-Group_W

Project Name: -

Project Number: -

Project Description: -

Project Designer: Dik

Last Revised (yy-mm-dd): 21-02-25

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**				

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

$pli := \frac{lbf}{in}$

Pressure

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

Subgrade Modulus

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

Pressure per Depth

$psfpf := \frac{psf}{ft}$ $\quad kPapm := \frac{kPa}{m}$

Force

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

Velocity

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

User Defined Functions:

c b a

```
Check(arg) := if  arg = 1
                  Check := "...OK"
              else
                  Check := "...NG"
```

$Check(2 = 3) = "...NG"$ $\quad Check(2 \le 3) = "...OK"$

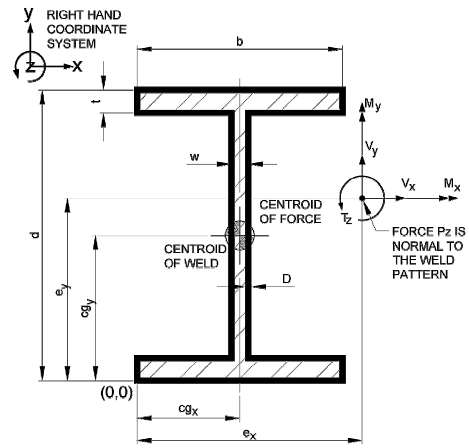
$Check(2 \ne 3) = "...OK"$ $\quad Check(3 \ge 2) = "...OK"$

Input Data

Material Property Factors:

$\varphi_s := 0.90$

$\varphi_w := 0.67$



Weld interface is taken at the face of the attached member rather than the centreline of the weld.

Load Factors:

$\alpha_L := 1.50$

$\alpha_D := 1.25$

Applied Factored Loads:

$P_{fz} := 0\ K$	$P_{fz} = 0.00\ kN$	Axial Load
$V_{fx} := 0\ K$	$V_{fx} = 0.00\ kN$	Shear (X-Axis)
$V_{fy} := 292\ K$	$V_{fy} = 1298.88\ kN$	Shear (Y-Axis)
$M_{fx} := 593\ K\_ft$	$M_{fx} = 804\ kN\_m$	Moment (X-Axis)
$M_{fy} := 0\ K\_ft$	$M_{fy} = 0.00\ kN\_m$	Moment (Y-Axis)
$T_{fz} := 0\ K\_ft$	$T_{fz} = 0.00\ kN\_m$	Torsion (Z-Axis)

Load Eccentricity:

$e_x := 6.375\ in$	$e_x = 161.9\ mm$	X-Axis Direction
$e_y := 12.03\ in$	$e_y = 305.6\ mm$	Y-Axis Direction
$e_z := 0\ in$	$e_z = 0.0\ mm$	Z-Axis Direction

W Shape Input Data:

$d := 24.06\ in$ $\quad d = 611.1\ mm$

$b := 12.75\ in$ $\quad b = 323.8\ mm$

$t := 0.75\ in$ $\quad t = 19\ mm$

$w := 0.50\ in$ $\quad w = 12.7\ mm$

$d' := d - 2 \cdot t$ $\quad d' = 22.56\ in$ $\quad d' = 573.02\ mm$

$b' := 0.5 \cdot (b - w)$ $\quad b' = 6.125\ in$ $\quad b' = 155.575\ mm$

$pts :=$

s	xi	yi	xj	yj
1	0 in	0 in	0 in	t
2	0 in	t	b'	t
3	b'	t	b'	$t + d'$
4	b'	$t + d'$	0 in	$t + d'$
5	0 in	$t + d'$	0 in	d
6	0 in	d	b	d
7	b	d	b	$t + d'$
8	b	$t + d'$	$b' + w$	$t + d'$
9	$b' + w$	$t + d'$	$b' + w$	t
10	$b' + w$	t	b	t
11	b	t	b	0 in
12	b	0 in	0 in	0 in

$pts' := \text{submatrix}(pts, 1, \text{rows}(pts), 2, 5)$

Used for Summary and Plotting Shape

$$\text{for } c \in [1..\text{rows}(pts')]$$
$$ptsn_{c\,1} := pts'_{c\,1} \cdot \frac{1}{in}$$
$$ptsn_{c\,2} := pts'_{c\,2} \cdot \frac{1}{in}$$
$$ptsn_{c\,3} := pts'_{c\,3} \cdot \frac{1}{in}$$
$$ptsn_{c\,4} := pts'_{c\,4} \cdot \frac{1}{in}$$

$c := 0$

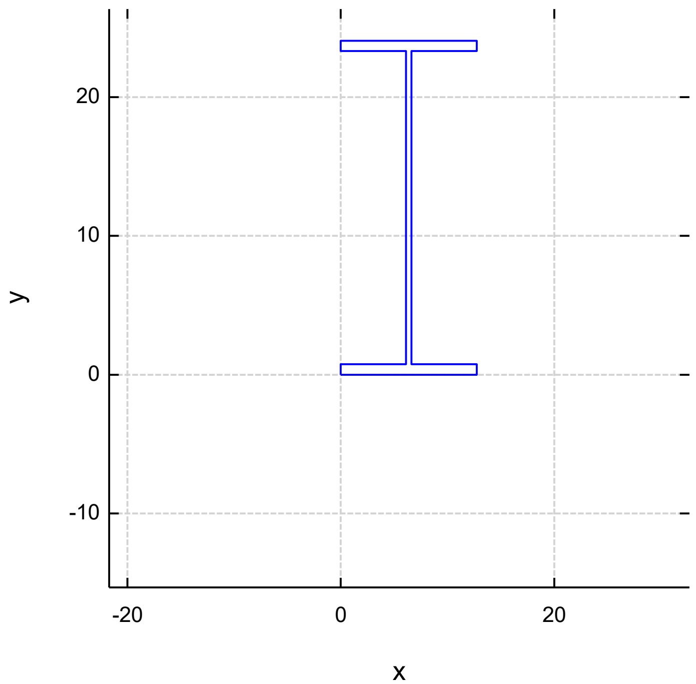
$$\text{for } c \in [1..\text{rows}(ptsn)]$$
$$weld_{c\,1} := ptsn_{c\,1}$$
$$weld_{c\,2} := ptsn_{c\,2}$$

$c := c + 1$

$weld_{c\,1} := ptsn_{1\,1}$

$weld_{c\,2} := ptsn_{1\,2}$

Weld Pattern



weld

Base Metal Steel Properties: $stl_{NDX} := 3$

$stl :=$

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

$desI_1 := stl_{stl_{NDX}\,2}$ $\quad f_{y1} := stl_{stl_{NDX}\,3}$

$F_{u1} := stl_{stl_{NDX}\,4}$

$E_s := 29000$ Ksi $\quad G_s := 10.9$ Ksi $\quad \gamma_s := 489$ pcf

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

$we :=$

NDX	DesI	DesM	UTS
1	"E60xx"	"E410xx"	60 ksi
2	"E70xx"	"E480xx"	70 ksi
3	"E80xx"	"E550xx"	80 ksi
4	"E90xx"	"E620xx"	90 ksi

$desI_w := we_{we_{NDX}\,2}$ $\quad X_u := we_{we_{NDX}\,4}$

$desM_w := we_{we_{NDX}\,3}$

Weld Sizes: $ws_{NDX} := 14$

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	"7/16"	""	0.4375 in
14	"1/2"	""	0.5 in

$ws :=$ (matrix above)

$desI_D := ws_{ws_{NDX}\, 2}$ $\quad desM_D := ws_{ws_{NDX}\, 3}$

$D := ws_{ws_{NDX}\, 4}$

Weld Strength:

$v_{rw} := \varphi_w \cdot 0.67 \cdot X_u$ $\quad v_{rw} = 31.4$ ksi $\quad v_{rw} = 216.7$ MPa $\quad$ Limit Weld Stress

Base Strength:

$v_{rb} := \varphi_s \cdot f_{y1}$ $\quad v_{rb} = 32.4$ Ksi $\quad v_{rb} = 223.4$ MPa $\quad$ Limit Base Metal Stress

Maximum Strength per Unit Length:

$v'_{rw} := v_{rw} \cdot D \cdot \frac{1}{\sqrt{2}}$ $\quad v'_{rw} = 11.1$ Kpi $\quad v'_{rw} = 1.9$ kNpmm $\quad$ Weld Resist per Unit Len

$v'_{rb} := v_{rb} \cdot D$ $\quad v'_{rb} = 16.2$ Kpi $\quad v'_{rb} = 2.8$ kNpmm $\quad$ Base Resist per Unit Len

$v_r := \min\left(\left[\begin{matrix} v'_{rw} & v'_{rb} \end{matrix}\right]\right)$ $\quad v_r = 11.1$ Kpi $\quad v_r = 1.9$ kNpmm $\quad$ Min Resist per Unit Len

Weld Properties:

for $r \in [1..\mathrm{rows}(pts)]$

$pts_{r\,6} := \frac{pts_{r\,2} + pts_{r\,4}}{2}$ $\quad c_x$

$pts_{r\,7} := \frac{pts_{r\,3} + pts_{r\,5}}{2}$ $\quad c_y$

$pts_{r\,8} := pts_{r\,4} - pts_{r\,2}$ $\quad m$

$pts_{r\,9} := pts_{r\,5} - pts_{r\,3}$ $\quad n$

$pts_{r\,10} := \sqrt{\left(pts_{r\,8}\right)^2 + \left(pts_{r\,9}\right)^2}$ $\quad L$

$pts_{r\,11} := \frac{pts_{r\,10} \cdot \left(pts_{r\,9}\right)^2}{12}$ $\quad I_{xx}$

$pts_{r\,12} := \frac{pts_{r\,10} \cdot \left(pts_{r\,8}\right)^2}{12}$ $\quad I_{yy}$

$pts_{r\,13} := pts_{r\,10} \cdot pts_{r\,6}$ $\quad$ L cx

$pts_{r\,14} := pts_{r\,10} \cdot pts_{r\,7}$ $\quad$ L cy for $r \in [1..\text{rows}(pts)]$

$pts_{r\,15} := pts_{r\,6} - cg_x$	d_x
$pts_{r\,16} := pts_{r\,7} - cg_y$	d_y
$pts_{r\,17} := pts_{r\,11} + pts_{r\,10} \cdot pts_{r\,16}^{\,2}$	I'_{xx}
$pts_{r\,18} := pts_{r\,12} + pts_{r\,10} \cdot \left(pts_{r\,15}\right)^2$	I'_{yy}
$pts_{r\,19} := pts_{r\,10} \cdot pts_{r\,15} \cdot pts_{r\,16}$	I'_{xy}
$pts_{r\,20} := pts_{r\,2} - cg_x$	d_{xi}
$pts_{r\,21} := pts_{r\,3} - cg_y$	d_{yi}
$pts_{r\,22} := pts_{r\,4} - cg_x$	d_{xj}
$pts_{r\,23} := pts_{r\,5} - cg_y$	d_{yj}

$A := \sum \text{col}(pts, 10)$	$A = 98.12$ in	$A = 2492.2$ mm	Total Length of Weld
$cg_x := \sum \left(\frac{\text{col}(pts, 13)}{A}\right)$	$cg_x = 6.38$ in	$cg_x = 161.9$ mm	Centroid of Weld X-Axis
$cg_y := \sum \left(\frac{\text{col}(pts, 14)}{A}\right)$	$cg_y = 12.03$ in	$cg_y = 305.6$ mm	Centroid of Weld Y-Axis
$I'_{xx} := \sum \text{col}(pts, 17)$	$I'_{xx} = 9129.0\ in^3$	$I'_{xx} = 1.50 \cdot 10^8\ mm^3$	Moment of Inertia (X-Axis)
$I'_{yy} := \sum \text{col}(pts, 18)$	$I'_{yy} = 815.6\ in^3$	$I'_{yy} = 1.34 \cdot 10^7\ mm^3$	Moment of Inertia (Y-Axis)
$I'_{xy} := \sum \text{col}(pts, 19)$	$I'_{xy} = -1.1 \cdot 10^{-12}\ in^3$	$I'_{xy} = -1.80 \cdot 10^{-8}\ mm^3$	Product of Inertia
$I'_p := I'_{xx} + I'_{yy}$	$I'_p = 9944.7\ in^3$	$I'_p = 1.63 \cdot 10^8\ mm^3$	Polar Moment of Inertia
$I'_{prod} := I'_{xx} \cdot I'_{yy} - I'^{\,2}_{xy}$	$I'_{prod} = 7.4 \cdot 10^6\ in^6$	$I'_{prod} = 2.00 \cdot 10^{15}\ mm^6$	Product of Inertia

Load Distance from Centroid:

$e'_x := e_x - cg_x$	$e'_x = 0.00$ in	$e'_x = 0$ mm	X-Axis Direction
$e'_y := e_y - cg_y$	$e'_y = 1.50 \cdot 10^{-14}$ in	$e'_y = 3.8211 \cdot 10^{-13}$ mm	Y-Axis Direction
$e'_z := e_z$	$e'_z = 0.00$ in	$e'_z = 0$ mm	Z-Axis Direction

Stress from Applied Factored Loads:

$\sigma_{fx} := \frac{V_{fx}}{A}$	$\sigma_{fx} = 0.00$ Kpi	$\sigma_{fx} = 0$ kNpmm	X-Axis Direction
$\sigma_{fy} := \frac{V_{fy}}{A}$	$\sigma_{fy} = 2.9759$ Kpi	$\sigma_{fy} = 0.5212$ kNpmm	Y-Axis Direction
$\sigma_{fz} := \frac{P_{fz}}{A}$	$\sigma_{fz} = 0$ Kpi	$\sigma_{fz} = 0$ kNpmm	Z-Axis Direction

Load at Weld Group Centroid:

$d_x := e_x - cg_x$	$d_x = 0.00$ in	$d_x = 0.00$ mm
$d_y := e_y - cg_y$	$d_y = 1.5044 \cdot 10^{-14}$ in	$d_y = 3.8211 \cdot 10^{-13}$ mm
$d_z := e_z$	$d_z = 0$ in	$d_z = 0$ mm
$M'_{fx} := M_{fx} - V_{fy} \cdot d_z + P_{fz} \cdot d_y$	$M'_{fx} = 593.00$ K_ft	$M'_{fx} = 804$ kN_m
$M'_{fy} := M_{fy} + V_{fx} \cdot d_z - P_{fz} \cdot d_x$	$M'_{fy} = 0$ K_ft	$M'_{fy} = 0$ kN_m
$T'_{fz} := T_{fz} - V_{fx} \cdot d_y + V_{fy} \cdot d_x$	$T'_{fz} = 0$ K_ft	$T'_{fz} = 0$ kN_m

```
for r ∈ [1..rows(pts)]
  if pts_{r 10} = 0 in
    pts_{r 24} := 0 pli                                         σz y from Mx      Stress at Start of Segment
    pts_{r 25} := 0 pli                                         σz y from My
    pts_{r 26} := 0 pli                                         σz x from Mx
    pts_{r 27} := 0 pli                                         σz x from My
    pts_{r 28} := pts_{r 24} + pts_{r 25} + pts_{r 26} + pts_{r 27}   Σσz from M
    pts_{r 29} := pts_{r 28} + σ_fz                             Σσz
    pts_{r 30} := 0 pli                                         σx from T
    pts_{r 31} := pts_{r 30} + σ_fx                             Σσx
    pts_{r 32} := 0 pli                                         σy from T
    pts_{r 33} := pts_{r 32} + σ_fy                             Σσy
    pts_{r 34} := sqrt(pts_{r 29}^2 + pts_{r 31}^2 + pts_{r 33}^2)    σy combined
    pts_{r 35} := 0 pli                                         σz y from Mx
  else
    pts_{r 24} := pts_{r 21}·M'_fx·I'_yy / I'_prod              σz y from My
    pts_{r 25} := pts_{r 21}·M'_fy·I'_xy / I'_prod              σz x from Mx
    pts_{r 26} := (-1·pts_{r 20})·M'_fx·I'_xy / I'_prod         σz x from My
    pts_{r 27} := (-1·pts_{r 20})·M'_fy·I'_xx / I'_prod         Σσz from M
    pts_{r 28} := pts_{r 24} + pts_{r 25} + pts_{r 26} + pts_{r 27}   Σσz
    pts_{r 29} := pts_{r 28} + σ_fz                             σx from T
    pts_{r 30} := (-1·pts_{r 21})·T'_fz / I'_p                  Σσx
    pts_{r 31} := pts_{r 30} + σ_fx                             σy from T
    pts_{r 32} := pts_{r 20}·T'_fz / I'_p                       Σσy
    pts_{r 33} := pts_{r 32} + σ_fy                             σy combined
    pts_{r 34} := sqrt((pts_{r 29})^2 + (pts_{r 31})^2 + (pts_{r 33})^2)   Σσy      Stress at Start of Segment
    pts_{r 35} := pts_{r 23}·M'_fx·I'_yy / I'_prod              σz y from Mx      Stress at End of Segment
```

for $r \in [1..\text{rows}(pts)]$

if $pts_{r\,10} = 0\ in$

$pts_{r\,36} := 0\ pli$	σz y from My
$pts_{r\,37} := 0\ pli$	σz x from Mx
$pts_{r\,38} := 0\ pli$	σz x from My
$pts_{r\,39} := pts_{r\,35} + pts_{r\,36} + pts_{r\,37} + pts_{r\,38}$	Σσz from M
$pts_{r\,40} := \left(pts_{r\,39} + \sigma_{fz}\right)$	Σσz
$pts_{r\,41} := 0\ pli$	σx from T
$pts_{r\,42} := pts_{r\,41} + \sigma_{fx}$	Σσx
$pts_{r\,43} := 0\ pli$	σy from T
$pts_{r\,44} := pts_{r\,43} + \sigma_{fy}$	Σσy
$pts_{r\,45} := \sqrt{\left(pts_{r\,40}\right)^2 + \left(pts_{r\,42}\right)^2 + \left(pts_{r\,44}\right)^2}$	σy combined
$pts_{r\,46} := 0\ pli$	σz y from Mx
$pts_{r\,47} := 0\ pli$	σz y from My
$pts_{r\,48} := 0\ pli$	σz x from Mx

else

$pts_{r\,36} := \dfrac{pts_{r\,23} \cdot M'_{fy} \cdot I'_{xy}}{I'_{prod}}$	σz y from My	
$pts_{r\,37} := \dfrac{\left(-1 \cdot pts_{r\,22}\right) \cdot M'_{fx} \cdot I'_{xy}}{I'_{prod}}$	σz x from Mx	
$pts_{r\,38} := \dfrac{\left(-1 \cdot pts_{r\,22}\right) \cdot M'_{fy} \cdot I'_{xx}}{I'_{prod}}$	σz x from My	
$pts_{r\,39} := pts_{r\,35} + pts_{r\,36} + pts_{r\,37} + pts_{r\,38}$	Σσz from M	
$pts_{r\,40} := \left(pts_{r\,39} + \sigma_{fz}\right)$	Σσz	
$pts_{r\,41} := \left(-\dfrac{1 \cdot pts_{r\,23} \cdot T'_{fz}}{I'_{p}}\right)$	σx from T	
$pts_{r\,42} := pts_{r\,41} + \sigma_{fx}$	Σσx	
$pts_{r\,43} := \dfrac{pts_{r\,22} \cdot T'_{fz}}{I'_{p}}$	σy from T	
$pts_{r\,44} := pts_{r\,43} + \sigma_{fy}$	Σσy	
$pts_{r\,45} := \sqrt{\left(pts_{r\,40}\right)^2 + \left(pts_{r\,42}\right)^2 + \left(pts_{r\,44}\right)^2}$	σy combined	Stress at End of Segment
$pts_{r\,46} := \dfrac{pts_{r\,16} \cdot M'_{fx} \cdot I'_{yy}}{I'_{prod}}$	σz y from Mx	Stress at Midpoint of Segment
$pts_{r\,47} := \dfrac{pts_{r\,16} \cdot M'_{fy} \cdot I'_{xy}}{I'_{prod}}$	σz y from My	
$pts_{r\,48} := \dfrac{\left(-1 \cdot pts_{r\,15} \cdot M'_{fx} \cdot I'_{xy}\right)}{I'_{prod}}$		

$\text{for } r \in [1..\text{rows}(pts)]$

- $\text{if } pts_{r\,10} = 0 \text{ in}$
  - $pts_{r\,49} := 0 \text{ pli}$ — σz x from Mx
  - σz x from My
  - $pts_{r\,50} := pts_{r\,46} + pts_{r\,47} + pts_{r\,48} + pts_{r\,49}$ — σz frin M
  - $pts_{r\,51} := pts_{r\,50} + \sigma_{fz}$ — σz Total
  - $pts_{r\,52} := 0 \text{ pli}$ — σx from T
  - $pts_{r\,53} := pts_{r\,52} \cdot \sigma_{fx}$ — σx Combined
  - $pts_{r\,54} := 0 \text{ pli}$ — σy from T
  - $pts_{r\,55} := pts_{r\,54} + \sigma_{fy}$ — σy Combined
  - $pts_{r\,56} := \sqrt{\left(pts_{r\,51}\right)^2 + \left(pts_{r\,53}\right)^2 + \left(pts_{r\,55}\right)^2}$ — Total σ
- else
  - $pts_{r\,49} := \dfrac{\left(-1 \cdot pts_{r\,15}\right) \cdot M'_{fy} \cdot I'_{xx}}{I'_{prod}}$ — σz x from My
  - $pts_{r\,50} := pts_{r\,46} + pts_{r\,47} + pts_{r\,48} + pts_{r\,49}$ — σz frin M
  - $pts_{r\,51} := pts_{r\,50} + \sigma_{fz}$ — σz Total
  - $pts_{r\,52} := \dfrac{\left(-1 \cdot pts_{r\,16}\right) \cdot T'_{fz}}{I'_p}$ — σx from T
  - $pts_{r\,53} := \left(pts_{r\,52} + \sigma_{fx}\right)$ — σx Combined
  - $pts_{r\,54} := \dfrac{pts_{r\,15} \cdot T'_{fz}}{I'_p}$ — σy from T
  - $pts_{r\,55} := pts_{r\,54} + \sigma_{fy}$ — σy Combined
  - $pts_{r\,56} := \sqrt{\left(pts_{r\,51}\right)^2 + \left(pts_{r\,53}\right)^2 + \left(pts_{r\,55}\right)^2}$ — Total σ — Stress at Midpoint of Segment

Max and Min Stress in Segment:

$\sigma'_z := \max(\text{col}(pts, 34))$	$\sigma'_z = 9.84$ Kpi	$\sigma'_z = 1.72$ kNpmm	Max Stress at Start of Segment
$op'_1 := \min(\text{col}(pts, 34))$	$op'_1 = 9$ Kpi	$op'_1 = 2$ kNpmm	Min Stress at Start of Segment
$\sigma'_x := \max(\text{col}(pts, 45))$	$\sigma'_x = 9.84$ Kpi	$\sigma'_x = 1.72$ kNpmm	Max Stress at End of Segment
$op'_2 := \min(\text{col}(pts, 45))$	$op'_2 = 9.2826$ Kpi	$op'_2 = 1.6256$ kNpmm	Min Stress at End of Segment
$\sigma'_y := \max(\text{col}(pts, 56))$	$\sigma'_y = 9.84$ Kpi	$\sigma'_y = 1.72$ kNpmm	Max Stress at Middle of Segment
$op'_3 := \min(\text{col}(pts, 56))$	$op'_3 = 2.9759$ Kpi	$op'_3 = 0.5212$ kNpmm	Min Stress at Middle of Segment

Max and Min Stress in Welds:

$op_{max} := \max([\sigma'_x \ \sigma'_y \ \sigma'_z])$	$op_{max} = 9.84$ Kpi	$op_{max} = 1.72$ kNpmm	Maximum Stress in Segment
$op'_{min} := \min([op'_1 \ op'_2 \ op'_3])$			
	$op'_{min} = 2.9759$ Kpi	$op'_{min} = 0.5212$ kNpmm	Minimum Stress in Segment
	$v_r = 11.11$ Kpi	$v_r = 1.9456$ kNpmm	Weld Resistance:

Summary:

Material Property Factors

Rolled Sections $\varphi_s = 0.9$

Weld $\varphi_w = 0.67$

Dead Load Factor $\alpha_D = 1.25$

Live Load Factor $\alpha_L = 1.5$

$Check\left(\alpha_D \geq 1.25\right) = \text{"...OK"}$

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

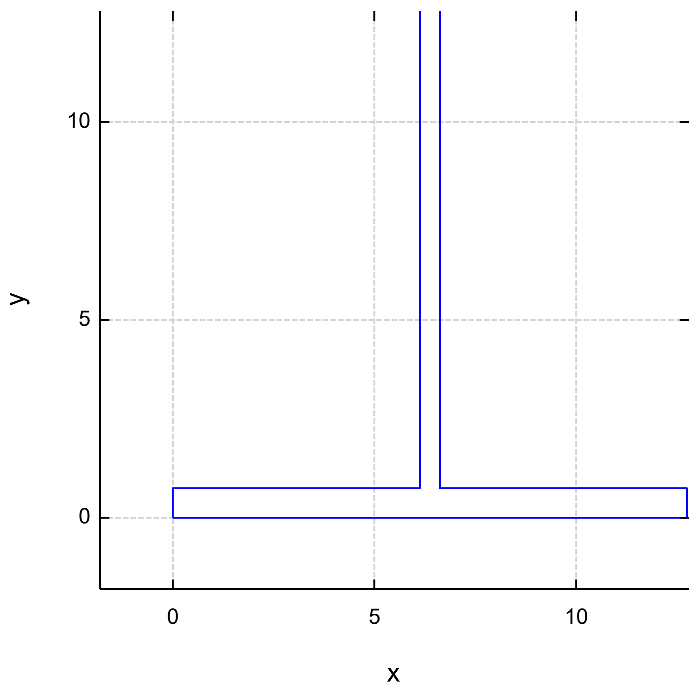
Applied Factored Loads:

Axial Load	$P_{fz} = 0\ K$	$P_{fz} = 0\ kN$
Shear (X-Axis)	$V_{fx} = 0\ K$	$V_{fx} = 0\ kN$
Shear (Y-Axis)	$V_{fy} = 292\ K$	$V_{fy} = 1298.8807\ kN$
Moment (X-Axis)	$M_{fx} = 593\ K\_ft$	$M_{fx} = 804\ kN\_m$
Moment (Y-Axis)	$M_{fy} = 0\ K\_ft$	$M_{fy} = 0\ kN\_m$
Torsion (Z-Axis)	$T_{fz} = 0\ K\_ft$	$T_{fz} = 0\ kN\_m$

Load Eccentricity from Origin:

X-Axis Direction	$e_x = 6.4\ in$	$e_x = 161.9\ mm$
Y-Axis Direction	$e_y = 12\ in$	$e_y = 305.6\ mm$
Z-Axis Direction	$e_z = 0\ in$	$e_z = 0\ mm$

Weld Pattern



$weld$

Segment Input Data:

Row Represents Segment Number
Columns represent S(xi, yi, xj, yj) coordinates

$$pts' = \begin{bmatrix} 0.0 & 0.0 & 0.0 & 0.8 \\ 0.0 & 0.8 & 6.1 & 0.8 \\ 6.1 & 0.8 & 6.1 & 23.3 \\ 6.1 & 23.3 & 0.0 & 23.3 \\ 0.0 & 23.3 & 0.0 & 24.1 \\ 0.0 & 24.1 & 12.8 & 24.1 \\ 12.8 & 24.1 & 12.8 & 23.3 \\ 12.8 & 23.3 & 6.6 & 23.3 \\ 6.6 & 23.3 & 6.6 & 0.8 \\ 6.6 & 0.8 & 12.8 & 0.8 \\ 12.8 & 0.8 & 12.8 & 0.0 \\ 12.8 & 0.0 & 0.0 & 0.0 \end{bmatrix} in$$

$$pts' = \begin{bmatrix} 0 & 0 & 0 & 19 \\ 0 & 19 & 155.6 & 19 \\ 155.6 & 19 & 155.6 & 592.1 \\ 155.6 & 592.1 & 0 & 592.1 \\ 0 & 592.1 & 0 & 611.1 \\ 0 & 611.1 & 323.8 & 611.1 \\ 323.8 & 611.1 & 323.8 & 592.1 \\ 323.8 & 592.1 & 168.3 & 592.1 \\ 168.3 & 592.1 & 168.3 & 19 \\ 168.3 & 19 & 323.8 & 19 \\ 323.8 & 19 & 323.8 & 0 \\ 323.8 & 0 & 0 & 0 \end{bmatrix} mm$$

Steel Base Properties

Designation	$desI_1 = $ "A36"	
Yield Strength	$f_{y1} = 36$ Ksi	$f_{y1} = 248$ MPa
Ultimate Strength	$F_{u1} = 58$ Ksi	$F_{u1} = 400$ MPa
Young's Modulus	$E_s = 29000$ Ksi	$E_s = 1.9995 \cdot 10^5$ MPa
Shear Modulus	$G_s = 10.9$ Ksi	$G_s = 75$ MPa
Density	$\gamma_s = 489$ pcf	$\gamma_s = 76.8158$ kNpcm

Welding Electrodes

Imperial Designation	$desI_w = $ "E70xx"	
Metric Designation	$desM_w = $ "E480xx"	
Ultimate Strength	$X_u = 70$ ksi	$X_u = 483$ MPa

Weld Size

Imperial Designation	$desI_D = $ "1/2"	
Metric Designation	$desM_D = $ ""	
Size	$D = 0.5$ in	$D = 12.7$ mm
Limit Weld Stress	$v_{rw} = 31.4$ ksi	$v_{rw} = 216.7$ MPa
Limit Base Metal Stress	$v_{rb} = 32.4$ Ksi	$v_{rb} = 223.4$ MPa
Weld Resist per Unit Len	$v'_{rw} = 11.1$ Kpi	$v'_{rw} = 1.9$ kNpmm
Base Resist per Unit Len	$v'_{rb} = 16.2$ Kpi	$v'_{rb} = 2.8$ kNpmm
Min Resistance per Unit Len	$v_r = 11.1$ Kpi	$v_r = 1.9$ kNpmm

Weld Properties

Total Length of Weld	$A = 98.12$ in	$A = 2492.2$ mm
Centroid of Weld X-Axis	$cg_x = 6.375$ in	$cg_x = 161.9$ mm
Centroid of Weld Y-Axis	$cg_y = 12.03$ in	$cg_y = 305.6$ mm
Moment of Inertia (X-Axis)	$I'_{xx} = 9129\ in^3$	$I'_{xx} = 1.50 \cdot 10^8\ mm^3$
Moment of Inertia (Y-Axis)	$I'_{yy} = 815.6\ in^3$	$I'_{yy} = 1.34 \cdot 10^7\ mm^3$
Product of Inertia	$I'_{xy} = -1.1 \cdot 10^{-12}\ in^3$	$I'_{xy} = -1.80 \cdot 10^{-8}\ mm^3$
Polar Moment of Inertia	$I'_p = 9944.7\ in^3$	$I'_p = 1.63 \cdot 10^8\ mm^3$
Prod of Moment of Inertia	$I'_{prod} = 7.4 \cdot 10^6\ in^6$	$I'_{prod} = 2.00 \cdot 10^{15}\ mm^6$

Weld Force from Direct Loads

X-Axis Direction	$\sigma_{fx} = 0.00$ Kpi	$\sigma_{fx} = 0.00$ kNpmm
Y-Axis Direction	$\sigma_{fy} = 2.98$ Kpi	$\sigma_{fy} = 0.52$ kNpmm
Z-Axis Direction	$\sigma_{fz} = 0.00$ Kpi	$\sigma_{fz} = 0.00$ kNpmm

Load at Weld Group Centroid:

Moment (X-Axis)	$M'_{fx} = 593$ K_ft	$M'_{fx} = 804$ kN_m
Moment (Y-Axis)	$M'_{fy} = 0$ K_ft	$M'_{fy} = 0$ kN_m
Torsion (Z-Axis)	$T'_{fz} = 0$ K_ft	$T'_{fz} = 0$ kN_m
Max Weld Force at Start of Segment in Pattern	$\sigma'_x = 9.838$ Kpi	$\sigma'_x = 1.72$ kNpmm

Min Weld Force at Start of Segment in Pattern	$op'_1 = 9.283$ Kpi	$op'_1 = 2$ kNpmm
Max Weld Force at End of Segment in Pattern	$\sigma'_y = 9.838$ Kpi	$\sigma'_y = 1.72$ kNpmm
Min Weld Force at End of Segment in Pattern	$op'_2 = 9.283$ Kpi	$op'_2 = 1.63$ kNpmm
Max Weld Force at Mid Point of Segment in Pattern	$\sigma'_z = 9.838$ Kpi	$\sigma'_z = 1.72$ kNpmm
Min Weld Force at Mid Point of Segment in Pattern	$op'_3 = 2.976$ Kpi	$op'_3 = 0.52$ kNpmm
Maximum Weld Force in Pattern	$op_{max} = 9.838$ Kpi	$op_{max} = 1.72$ kNpmm
Minimum Weld Force in Pattern	$op'_{min} = 2.976$ Kpi	$op'_{min} = 0.52$ kNpmm
Weld Resistance:	$v_r = 11.110$ Kpi	$v_r = 1.95$ kNpmm

$Check\left(v_r \geq op_{max}\right) =$ "...OK"

$Check\left(v_r \geq 0.95 \cdot op_{max}\right) =$ "...OK"

$Check\left(v_r \geq \left|op'_{min}\right|\right) =$ "...OK"