NorthWoods Software

Program Name: Prop-W_BU

Project Number: -

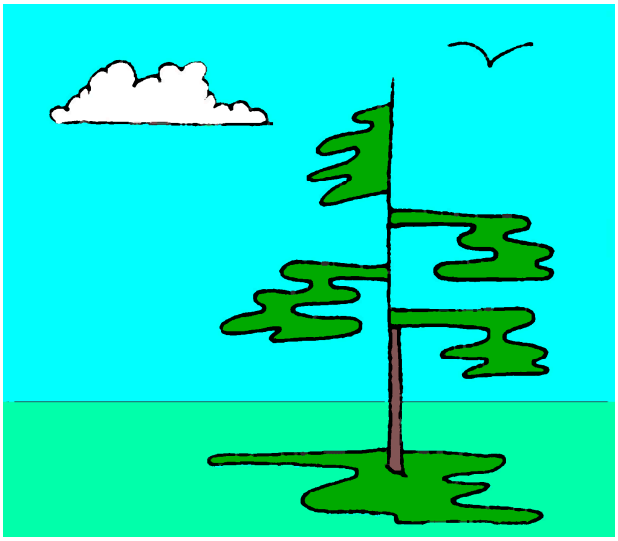
Project Description: -

Project Designer: Dik

Last Revised (yy-mm-dd): 22.01.20

Reference: NBCC, CSA S16

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



Menu:

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

Input Data

Material Property Factors:

$\varphi_s := 0.90$ Rolled Sections

$\varphi_w := 0.67$ Weld

$\varphi_b := 0.80$ Bolt

$\varphi_{br} := 0.80$ Bolt Bearing

Load Factors:

$\alpha_D := 1.25$

$\alpha_L := 1.5$

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

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

Steel Properties:

Section: $st_{NDX} := 2$

$st :=$

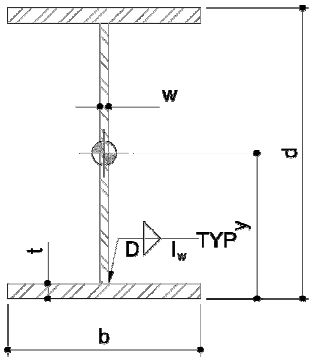
NDX	des	fy	Fu
1	"G40.21-350W"	50 Ksi	65 Ksi
2	"G40.21-300W"	44 Ksi	65 Ksi
3	"A36"	36 Ksi	58 Ksi

$desI_1 := st_{st_{NDX},2}$ $f_{y1} := st_{st_{NDX},3}$

$F_{u1} := st_{st_{NDX},4}$ $E_s := 29000\ Ksi$

$\nu := 0.3$ $G_s := \frac{E_s}{2 \cdot (1 + \nu)}$ $G_s = 11154\ Ksi$ $\gamma_s := 489\ pcf$

$desI_W := "HP12x53"$	$desI_W = "HP12x53"$		Designation Imperial
$desM_W := "HP310x79"$	$desM_W = "HP310x79"$		Designation Metric
$d_W := 11.78\ in$	$d_W = 11.78\ in$	$d_W = 299.2\ mm$	W Depth
$b_W := 12.05\ in$	$b_W = 12.05\ in$	$b_W = 306.1\ mm$	W Width
$t_W := 0.435\ in$	$t_W = 0.44\ in$	$t_W = 11.0\ mm$	W Flange Thickness
$w_W := 0.435\ in$	$w_W = 0.44\ in$	$w_W = 11\ mm$	W Web Thickness
	c	b	a



$desI_W = "HP12x53"$	$desM_W = "HP310x79"$		Designation
$d_W = 11.8\ in$	$d_W = 299.2\ mm$	C	W Depth
$b_W = 12\ in$	$b_W = 306.1\ mm$		W Width
$t_W = 0.4\ in$	$t_W = 11.0\ mm$		W Flange Thickness
$w_W = 0.4\ in$	$w_W = 11\ mm$		W Web Thickness

Section Properties:

$y_W := \frac{d_W}{2}$	$y_W = 5.89\ in$	$y_W = 149.6\ mm$	Depth to Outer Fibre
$A_W := 2 \cdot b_W \cdot t_W + \left(d_W - 2 \cdot t_W\right) \cdot w_W$	$A_W = 15.23\ in^2$	$A_W = 9825\ mm^2$	Area
$Ix_W := \frac{1}{12} \cdot \left(b_W \cdot {d_W}^3 - \left(b_W - w_W\right) \cdot \left(d_W - 2 \cdot t_W\right)^3\right)$	$Ix_W = 384.57\ in^4$	$Ix_W = 1.60 \cdot 10^8\ mm^4$	Moment of Inertia (X-Axis)
$Sx_W := \frac{1}{6 \cdot d_W} \cdot \left(b_W \cdot {d_W}^3 - \left(b_W - w_W\right) \cdot \left(d_W - 2 \cdot t_W\right)^3\right)$	$Sx_W = 65.29\ in^3$	$Sx_W = 1.07 \cdot 10^6\ mm^3$	Section Modulus (X-Axis)
$rx_W := \sqrt{\frac{Ix_W}{A_W}}$	$rx_W = 5.03\ in$	$rx_W = 127.6\ mm$	Radius of Gyration (X-Axis)
$Zx_W := \frac{1}{4} \cdot \left(b_W \cdot {d_W}^2 - \left(b_W - w_W\right) \cdot \left(d_W - 2 \cdot t_W\right)^2\right)$	$Zx_W = 72.41\ in^3$	$Zx_W = 1.19 \cdot 10^6\ mm^3$	Plastic Section (X-Axis)
$Iy_W := \frac{1}{12} \cdot \left(2 \cdot t_W \cdot {b_W}^3 + \left(d_W - 2 \cdot t_W\right) \cdot {w_W}^3\right)$	$Iy_W = 126.93\ in^4$	$Iy_W = 5.28 \cdot 10^7\ mm^4$	Moment of Inertia (Y-Axis)
$Sy_W := \frac{1}{6 \cdot b_W} \cdot \left(2 \cdot t_W \cdot {b_W}^3 + \left(d_W - 2 \cdot t_W\right) \cdot {w_W}^3\right)$	$Sy_W = 21.07\ in^3$	$Sy_W = 3 \cdot 10^5\ mm^3$	Section Modulus (Y-Axis)
$ry_W := \sqrt{\frac{Iy_W}{A_W}}$	$ry_W = 2.89\ in$	$ry_W = 73.3\ mm$	Radius of Gyration (Y-Axis)
$Zy_W := \frac{1}{4} \cdot \left(2 \cdot t_W \cdot \left({b_W}^2 - {w_W}^2\right) + {d_W} \cdot {w_W}^2\right)$	$Zy_W = 32.10\ in^3$	$Zy_W = 5 \cdot 10^5\ mm^3$	Plastic Section (Y-Axis)
$Ip_W := Ix_W + Iy_W$	$Ip_W = 511.50\ in^4$	$Ip_W = 2.13 \cdot 10^8\ mm^4$	Polar Moment of Inertia
$Cw_W := Iy_W \cdot \frac{{d_W}^2}{4}$	$Cw_W = 4403.38\ in^6$	$Cw_W = 1.18 \cdot 10^{12}\ mm^6$	Warping Constant
$J_W := \frac{2 \cdot b_W \cdot {t_W}^3}{3} + \frac{\left(d_W - t_W\right) \cdot {w_W}^3}{3}$	$J_W = 0.97\ in^4$	$J_W = 4 \cdot 10^5\ mm^4$	Torsional Constant
$r_{tW} := \left(\frac{\left(\frac{Iy_W}{2} - \left(\frac{\left(\left(\frac{\left(d_W - 2 \cdot t_W\right)}{3}\right) \cdot {w_W}^3\right)}{12}\right)\right)}{\frac{A_W}{2} - \left(\left(\frac{\left(d_W - 2 \cdot t_W\right)}{3}\right) \cdot w_W\right)}\right)^{0.5}$	$r_{tW} = 3.24\ in$	$r_{tW} = 82.37\ mm$	rt Constant

Class of Section

$bt_1 := \frac{145}{\sqrt{\frac{f_{y1}}{MPa}}}$ $bt_1 = 8.325$ b/t Ratio Class 1

$bt_2 := \frac{170}{\sqrt{\frac{f_{y1}}{MPa}}}$ $bt_2 = 9.7603$ b/t Ratio Class 2

$bt_3 := \frac{200}{\sqrt{\frac{f_{y1}}{MPa}}}$ $bt_3 = 11.4827$ b/t Ratio Class 3

$dw_1 := \frac{1600}{\sqrt{\frac{f_{y1}}{MPa}}}$ $dw_1 = 91.8616$ d/w Ratio Class 1

$dw_2 := \frac{1700}{\sqrt{\frac{f_{y1}}{MPa}}}$ $dw_2 = 97.603$ d/w Ratio Class 2

$dw_3 := \frac{1900}{\sqrt{\frac{f_{y1}}{MPa}}}$ $dw_3 = 109.0857$ d/w Ratio Class 3

if $\left(\left(\frac{b_W}{2 \cdot t_W}\right) \le bt_1\right) \wedge \left(\frac{d_W}{w_W} \le dw_1\right)$
  $Class := 1$
else
  if $\left(\left(\left(\frac{b_W}{2 \cdot t_W}\right) \le bt_2\right) \wedge \left(\frac{d_W}{w_W} \le dw_2\right)\right)$
    $Class := 2$
  else
    if $\left(\frac{b_W}{2 \cdot t_W} \le bt_3\right) \wedge \left(\frac{d_W}{w_W} \le dw_3\right)$
      $Class := 3$
    else
      $Class := 4$

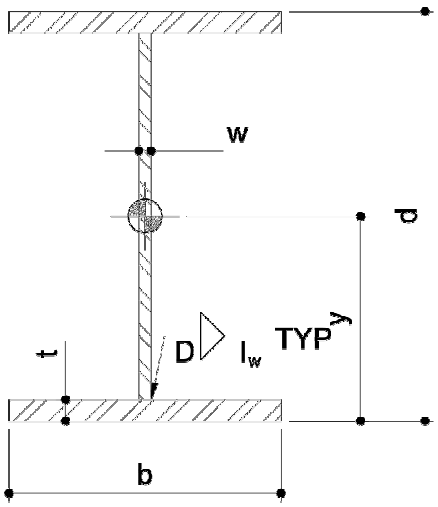
$Class = 4$

if $(Class = 1) \vee (Class = 2)$
  $M_r := \varphi_s \cdot Zx_W \cdot f_{y1}$
else
  $M_r := \varphi_s \cdot Sx_W \cdot f_{y1}$

$M_r = 215.46\ K\_ft$ $M_r = 292.13\ kN\_m$ Moment Resistance

c b a

Summary:



Section Properties

Designation	$desI_W = \text{"HP12x53"}$	$desM_W = \text{"HP310x79"}$
Area	$A_W = 15.23\ in^2$	$A_W = 9825\ mm^2$
Moment of Inertia (X-Axis)	$Ix_W = 384.57\ in^4$	$Ix_W = 1.60 \cdot 10^8\ mm^4$
Section Modulus (X-Axis)	$Sx_W = 65.29\ in^3$	$Sx_W = 1.07 \cdot 10^6\ mm^3$
Radius of Gyration (X-Axis)	$rx_W = 5.03\ in$	$rx_W = 127.6\ mm$
Plastic Section (X-Axis)	$Zx_W = 72.41\ in^3$	$Zx_W = 1.19 \cdot 10^6\ mm^3$
Moment of Inertia (Y-Axis)	$Iy_W = 126.93\ in^4$	$Iy_W = 5.28 \cdot 10^7\ mm^4$
Section Modulus (Y-Axis)	$Sy_W = 21.07\ in^3$	$Sy_W = 3.45 \cdot 10^5\ mm^3$
Radius of Gyration (Y-Axis)	$ry_W = 2.89\ in$	$ry_W = 73.3\ mm$
Plastic Section (Y-Axis)	$Zy_W = 32.10\ in^3$	$Zy_W = 5.26 \cdot 10^5\ mm^3$
Moment of Inertia (Polar)	$Ip_W = 511.50\ in^4$	$Ip_W = 2.13 \cdot 10^8\ mm^4$
Warping Constant	$Cw_W = 4403.38\ in^6$	$Cw_W = 1.18 \cdot 10^{12}\ mm^6$
Torsional Constant	$J_W = 0.97\ in^4$	$J_W = 4 \cdot 10^5\ mm^4$
rt Constant	$r_{tW} = 3.24\ in$	$r_{tW} = 82.4\ mm$
Class of Section	$Class = 4$	
Moment Resistance	$M_r = 215.5\ K\_ft$	$M_r = 292.1\ kN\_m$