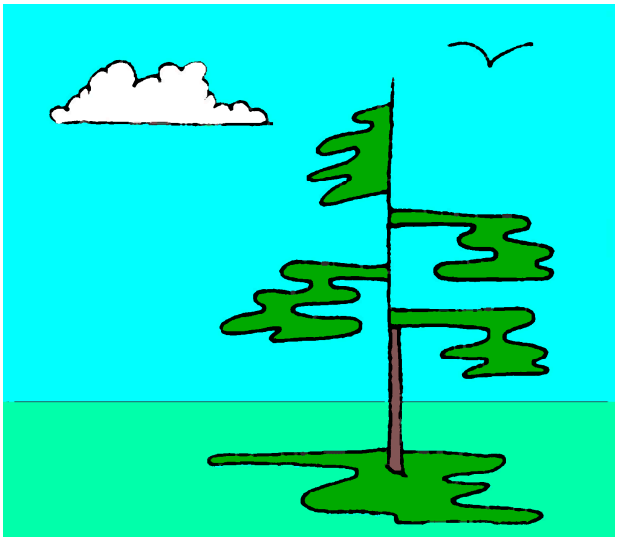
NorthWoods Software



Program Name: Load-Container

Project Number: -

Project Description: -

Project Designer: Dik

Last Revised (yy-mm-dd): 21.09.23

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:

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Defined Units:

$K := kip$ — Force

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

$kNmpm := \frac{kN\_m}{m}$ $iKpi := \frac{K\_in}{in}$ — Moment

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

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

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

$Npsmm := \frac{N}{mm^2}$ — Pressure

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

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

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

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

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

c b a

Load Factors:

Dead Load:

$\alpha_{D1} := 1.40$

$\alpha_{D2} := 1.25$

$\alpha_{D3} := 1.00$

$\alpha_{D4} := 0.90$

Live Load:

$\alpha_{L1} := 1.50$

$\alpha_{L2} := 0.50$

Snow Load:

$\alpha_{S1} := 1.50$

$\alpha_{S2} := 0.50$

$\alpha_{S3} := 0.25$

Wind Load:

$\alpha_{W1} := 1.40$

$\alpha_{W2} := 0.50$

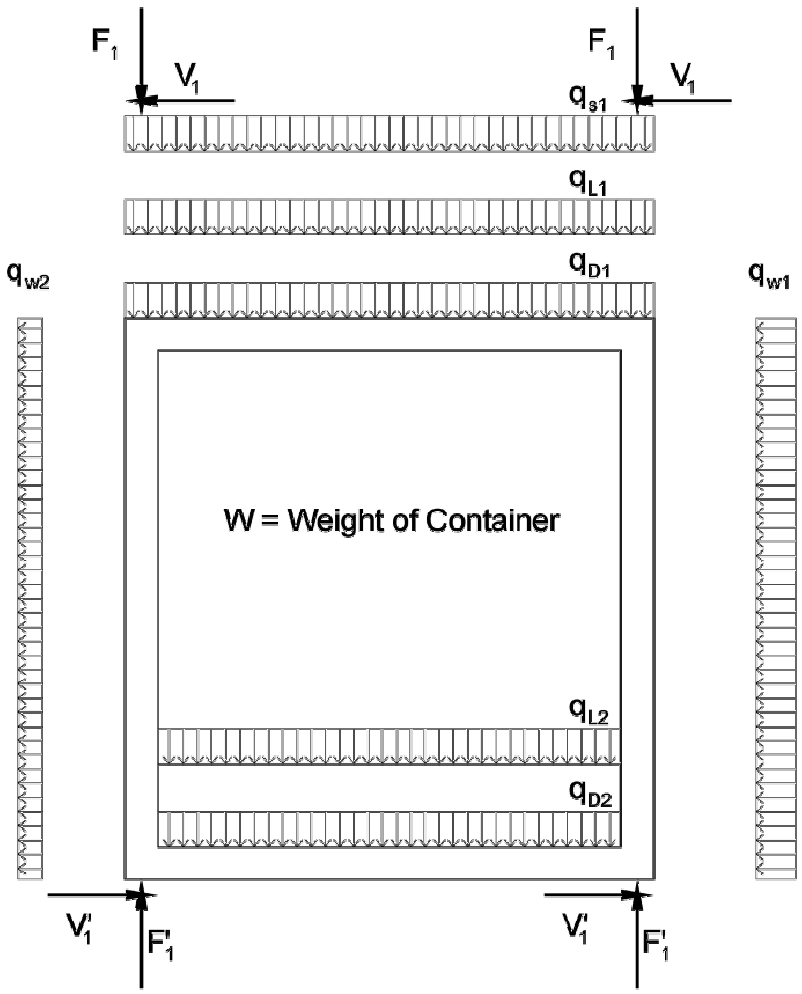
$\alpha_{W3} := 0.40$

Pattern Load:

$\alpha_{PL1} := 0.75$

Seismic Load:

$\alpha_{E1} := 1.00$



Input Data:

Container

$l := 20\ ft$	$l = 20.00\ ft$	$l = 6.10\ m$	Container Length
$w := 8\ ft$	$w = 8.00\ ft$	$w = 2.44\ m$	Container Width
$h := 8.5\ ft$	$h = 8.50\ ft$	$h = 2.59\ m$	Container Height
$t := 4\ in$	$t = 4.00\ in$	$t = 101.60\ mm$	Container Wall t
$W := 5\ K$	$W = 5.00\ K$	$W = 22.24\ kN$	Container Weight

Loads on Top Surface

$q_{L1} := 0\ Ksf$	$q_{L1} = 0.00\ Ksf$	$q_{L1} = 0.00\ kPa$
$q_{D1} := 0\ Ksf$	$q_{D1} = 0.00\ Ksf$	$q_{D1} = 0.00\ kPa$

Loads on Bottom Surface

$q_{L2} := 0\ psf$	$q_{L2} = 0\ psf$	$q_{L2} = 0\ kPa$
$q_{D2} := 15\ psf$	$q_{D2} = 15\ psf$	$q_{D2} = 0.7182\ kPa$

Climatic Data:

$S_s := 39.68\ psf$ $S_s = 39.68\ psf$ $S_s = 1.9\ kPa$

$S_r := 4.18\ psf$ $S_r = 4.18\ psf$ $S_r = 0.2\ kPa$

$q_{50} := 9.40\ psf$ $q_{50} = 9.4\ psf$ $q_{50} = 0.45\ kPa$

$C_{pe1} := 0.8$

$C_{pe2} := 0.5$ $q_{D2} = 15\ psf$

$C_g := 2.0$ Windward

$C_e := 1.0$ Leeward

Applied Point Loads at Top Surface (Initialise):

$F_{1D} := 0\ Klf$	$V_{1D} := 0\ Klf$	Dead Load
$F_{1L} := 0\ Klf$	$V_{1L} := 0\ Klf$	Live Load
$F_{1S} := 0\ Klf$	$V_{1S} := 0\ Klf$	Snow Load
$F_{1W} := 0\ Klf$	$V_{1W} := 0\ Klf$	Wind Load
$F_{1PL} := 0\ Klf$	$V_{1PL} := 0\ Klf$	Pattern Load
$F_{1E} := 0\ Klf$	$V_{1E} := 0\ Klf$	Seismic Load

$q_{s1} := 0.8 \cdot S_s + S_r$ $q_{s1} = 35.92\ psf$ $q_{s1} = 1.72\ kPa$ Snow Load

$q_{w1} := C_{pe1} \cdot C_g \cdot C_e \cdot q_{50}$ $q_{w1} = 15.04\ psf$ $q_{w1} = 0.72\ kPa$ Windward Load

$q_{w2} := C_{pe2} \cdot C_g \cdot C_e \cdot q_{50}$ $q_{w2} = 9.40\ psf$ $q_{w2} = 0.45\ kPa$ Leeward Load

Loads for Combinations at Reaction for F'1 (Loading +ve in direction shown)

Dead Load

$$D_L := F_{1D} + \frac{W}{2 \cdot l} + \frac{q_{D1} \cdot w}{2} + \frac{q_{D2} \cdot (w - 2 \cdot t)}{2}$$

$D_L = 0.18\ Klf$ $D_L = 2.63\ kNpm$

Live Load

$$L_L := F_{1L} + \frac{q_{L1} \cdot w}{2} + \frac{q_{L2} \cdot (w - 2 \cdot t)}{2}$$

$L_L = 0\ Klf$ $L_L = 0.00\ kNpm$

Snow Load

$$S_L := F_{1S} + \frac{q_{s1} \cdot w}{2}$$

$S_L = 0.14\ Klf$ $S_L = 2.1\ kNpm$

Wind Load

$w_L := (q_{w1} + q_{w2}) \cdot h$ $w_L = 0.208\ Klf$ $w_L = 3.032\ kNpm$

$$W_L := \frac{w_L \cdot h}{2 \cdot (w - t)} + V_{1W} \cdot \frac{h}{(w - t)}$$

$W_L = 0.115\ Klf$ $W_L = 1.681\ kNpm$

Pattern Load

$PL_L := 0$ $PL_L = 0.000\ Klf$ $PL_L = 0.000\ kNpm$ No Pattern Loading

Seismic Load

$E_L := 0\ Klf$ $E_L = 0.000\ Klf$ $E_L = 0.000\ kNpm$ No Seismic Loading

Reactions

$F'_{1D} := D_L$	$F'_{1D} = 0.18\ \text{Klf}$	$F'_{1D} = 0.18\ \text{Klf}$	Dead Load
$F'_{1L} := L_L$	$F'_{1L} = 0.000\ \text{Klf}$	$F'_{1L} = 0\ \text{Klf}$	Live Load
$F'_{1S} := S_L$	$F'_{1S} = 0.144\ \text{Klf}$	$F'_{1S} = 0.144\ \text{Klf}$	Snow Load
$F'_{1W} := W_L$	$F'_{1W} = 0.115\ \text{Klf}$	$F'_{1W} = 0.115\ \text{Klf}$	Wind Load
$F'_{1PL} := PL_L$	$F'_{1PL} = 0.000\ \text{Klf}$	$F'_{1PL} = 0.000\ \text{Klf}$	Pattern Load
$F'_{1E} := E_L$	$F'_{1E} = 0.000\ \text{Klf}$	$F'_{1E} = 0.000\ \text{Klf}$	Seismic Load
$V'_{1W} := V_{1W} + w_L$	$V'_{1W} = 0.208\ \text{Klf}$	$V'_{1W} = 0.208\ \text{Klf}$	Wind Load (Shear)

Load Combinations (Line Load)

$q_1 := 1.4 \cdot D_L$	8.3.2 T C.1 Case 1
$q_2 := 1.25 \cdot D_L + 1.5 \cdot L_L$	8.3.2 T C.1 Case 2
$q_3 := 1.25 \cdot D_L + 1.5 \cdot L_L + 0.5 \cdot S_L$	
$q_4 := 1.25 \cdot D_L + 1.5 \cdot L_L + 0.4 \cdot W_L$	
$q_5 := 1.25 \cdot D_L + 1.5 \cdot L_L - 0.4 \cdot W_L$	
$q_6 := 0.9 \cdot D_L + 1.5 \cdot L_L$	
$q_7 := 0.9 \cdot D_L + 1.5 \cdot L_L + 0.5 \cdot S_L$	
$q_8 := 0.9 \cdot D_L + 1.5 \cdot L_L + 0.4 \cdot W_L$	
$q_9 := 0.9 \cdot D_L + 1.5 \cdot L_L - 0.4 \cdot W_L$	
$q_{10} := 1.24 \cdot D_L + 1.5 \cdot \left(0.75 \cdot PL_L\right)$	13.8.4.3
$q_{11} := 1.25 \cdot D_L + 1.5 \cdot S_L$	8.3.2 T C.1 Case 3
$q_{12} := 1.25 \cdot D_L + 1.5 \cdot S_L + 0.5 \cdot L_L$	
$q_{13} := 1.25 \cdot D_L + 1.5 \cdot S_L + 0.4 \cdot W_L$	
$q_{14} := 0.9 \cdot D_L + 1.5 \cdot S_L$	
$q_{15} := 0.9 \cdot D_L + 1.5 \cdot S_L + 0.5 \cdot L_L$	
$q_{16} := 0.9 \cdot D_L + 1.5 \cdot S_L + 0.4 \cdot W_L$	
$q_{17} := 0.9 \cdot D_L + 1.5 \cdot S_L - 0.4 \cdot W_L$	
$q_{18} := 1.25 \cdot D_L + 1.4 \cdot W_L$	8.3.2 T C.1 Case 4
$q_{19} := 1.25 \cdot D_L - 1.4 \cdot W_L$	
$q_{20} := 1.25 \cdot D_L + 0.5 \cdot L_L + 1.4 \cdot W_L$	
$q_{21} := 1.25 \cdot D_L + 0.5 \cdot L_L - 1.4 \cdot W_L$	
$q_{22} := 1.25 \cdot D_L + 0.5 \cdot S_L + 1.4 \cdot W_L$	
$q_{23} := 1.25 \cdot D_L + 0.5 \cdot S_L - 1.4 \cdot W_L$	
$q_{24} := 0.9 \cdot D_L + 1.4 \cdot W_L$	
$q_{25} := 0.9 \cdot D_L - 1.4 \cdot W_L$	
$q_{26} := 0.9 \cdot D_L + 0.5 \cdot L_L + 1.4 \cdot W_L$	
$q_{27} := 0.9 \cdot D_L + 0.5 \cdot L_L - 1.4 \cdot W_L$	

$q_{28} := 0.9 \cdot D_L + 0.5 \cdot S_L + 1.4 \cdot W_L$ 8.3.2 T C.1 Case 4

$q_{29} := 0.9 \cdot D_L + 0.5 \cdot S_L - 1.4 \cdot W_L$

$q_{30} := 1.0 \cdot D_L + 1.0 \cdot E_L$

$q_{31} := 1.0 \cdot D_L - 1.0 \cdot E_L$

$q_{32} := 1.0 \cdot D_L + 0.5 \cdot L_L + 1.0 \cdot E_L$

$q_{33} := 1.0 \cdot D_L + 0.5 \cdot L_L - 1.0 \cdot E_L$

$q_{34} := 1.0 \cdot D_L + 0.25 \cdot S_L + 1.0 \cdot E_L$

$q_{35} := 1.0 \cdot D_L + 0.25 \cdot S_L - 1.0 \cdot E_L$

$q_{36} := 1.0 \cdot D_L + 0.5 \cdot L_L + 0.25 \cdot S_L + 1.0 \cdot E_L$

$q_{37} := 1.0 \cdot D_L + 0.5 \cdot L_L + 0.25 \cdot S_L - 1.0 \cdot E_L$

$q_{1fmax} := \max\left(\left[\begin{array}{cccccccccccccccccc} q_1 & q_2 & q_3 & q_4 & q_5 & q_6 & q_7 & q_8 & q_9 & q_{10} & q_{11} & q_{12} & q_{13} & q_{14} & q_{15} & q_{16} & q_{17} & q_{18} & q_{19} & q_{20} \end{array}\right]\right)$

$q_{2fmax} := \max\left(\left[\begin{array}{cccccccccccccccc} q_{21} & q_{22} & q_{23} & q_{24} & q_{25} & q_{26} & q_{27} & q_{28} & q_{29} & q_{30} & q_{31} & q_{32} & q_{33} & q_{34} & q_{35} & q_{36} & q_{37} \end{array}\right]\right)$

$q_{fmax1} := \max\left(\left[\begin{array}{cc} q_{1fmax} & q_{2fmax} \end{array}\right]\right)$ $q_{fmax1} = 0.487\ \text{Klf}$ $q_{fmax1} = 7.102\ \text{kNpm}$

$q_{1fmin} := \min\left(\left[\begin{array}{cccccccccccccccccc} q_1 & q_2 & q_3 & q_4 & q_5 & q_6 & q_7 & q_8 & q_9 & q_{10} & q_{11} & q_{12} & q_{13} & q_{14} & q_{15} & q_{16} & q_{17} & q_{18} & q_{19} & q_{20} \end{array}\right]\right)$

$q_{2fmin} := \min\left(\left[\begin{array}{cccccccccccccccc} q_{21} & q_{22} & q_{23} & q_{24} & q_{25} & q_{26} & q_{27} & q_{28} & q_{29} & q_{30} & q_{31} & q_{32} & q_{33} & q_{34} & q_{35} & q_{36} & q_{37} \end{array}\right]\right)$

$q_{fmin1} := \min\left(\left[\begin{array}{cc} q_{1fmin} & q_{2fmin} \end{array}\right]\right)$ $q_{fmin1} = 0.001\ \text{Klf}$ $q_{fmin1} = 0.011\ \text{kNpm}$

Summary:

Container Dimensions

Container Length	$l = 20.00$ ft	$l = 6.096$ m
Container Width	$w = 8.00$ ft	$w = 2.438$ m
Container Height	$h = 8.50$ ft	$h = 2.591$ m
Container Wall t	$t = 4$ in	$t = 102$ mm

Container Loads

Container Weight	$W = 5.000$ K	$W = 22.241$ kN
Live Load Top Surface	$q_{L1} = 0.000$ psf	$q_{L1} = 0.000$ kPa
Dead Load Top Surface	$q_{D1} = 0.000$ psf	$q_{D1} = 0.000$ kPa
Live Load Bottom Surface	$q_{L2} = 0.000$ psf	$q_{L2} = 0.000$ kPa
Dead Load Bottom Surface	$q_{D2} = 15.000$ psf	$q_{D2} = 0.718$ kPa

Climatic Loads

Ground Snow Load	$S_s = 39.680$ psf	$S_s = 1.900$ kPa
Rain Load	$S_r = 4.180$ psf	$S_r = 0.200$ kPa
1/50 Year Return Wind Load	$q_{50} = 9.400$ psf	$q_{50} = 0.450$ kPa
Windward Pressure Coef	$C_{pe1} = 0.80$	
Leeward Pressure Coef	$C_{pe2} = 0.50$	
Gust Coef	$C_g = 2.00$	
Exposure Coef	$C_e = 1.00$	

Design Loads

Design Snow Load	$q_{s1} = 35.924$ psf	$q_{s1} = 1.720$ kPa
Design Wind Load (Windward)	$q_{w1} = 15.040$ psf	$q_{w1} = 0.720$ kPa
Design Wind Load (Leeward)	$q_{w2} = 9.400$ psf	$q_{w2} = 0.450$ kPa

Applied Point Load at Top

Dead Load	$F_{1D} = 0.000$ Klf	$F_{1D} = 0.000$ kNpm
Live Load	$F_{1L} = 0.000$ Klf	$F_{1L} = 0.000$ kNpm
Snow Load	$F_{1S} = 0.000$ Klf	$F_{1S} = 0.000$ kNpm
Wind Load	$F_{1W} = 0.000$ Klf	$F_{1W} = 0.000$ kNpm
Pattern Load	$F_{1PL} = 0.000$ Klf	$F_{1PL} = 0.000$ kNpm
Seismic Load	$F_{1E} = 0.000$ Klf	$F_{1E} = 0.000$ kNpm

Applied Shear Load at Top

Dead Load	$V_{1D} = 0.000$ Klf	$V_{1D} = 0.000$ kNpm
Live Load	$V_{1L} = 0.000$ Klf	$V_{1L} = 0.000$ kNpm
Snow Load	$V_{1S} = 0.000$ Klf	$V_{1S} = 0.000$ kNpm
Wind Load	$V_{1W} = 0.000$ Klf	$V_{1W} = 0.000$ kNpm
Pattern Load	$V_{1PL} = 0.000$ Klf	$V_{1PL} = 0.000$ kNpm
Seismic Load	$V_{1E} = 0.000$ Klf	$V_{1E} = 0.000$ kNpm

Reactions (Service Load)

Dead Load	$F'_{1D} = 0.180$ Klf	$F'_{1D} = 0.180$ Klf
Live Load	$F'_{1L} = 0.000$ Klf	$F'_{1L} = 0.000$ Klf
Snow Load	$F'_{1S} = 0.144$ Klf	$F'_{1S} = 0.144$ Klf
Wind Load	$F'_{1W} = 0.115$ Klf	$F'_{1W} = 0.115$ Klf
Pattern Load	$F'_{1PL} = 0.000$ Klf	$F'_{1PL} = 0.000$ Klf
Seismic Load	$F'_{1E} = 0.000$ Klf	$F'_{1E} = 0.000$ Klf
Wind Load (Shear)	$V'_{1W} = 0.208$ Klf	$V'_{1W} = 0.208$ Klf

Factored Reactions

Maximum	$q_{fmax1} = 0.487$ Klf	$q_{fmax1} = 7.102$ kNpm
Minimum	$q_{fmin1} = 0.001$ Klf	$q_{fmin1} = 0.011$ kNpm