
STRUCTURAL CALCULATIONS

FOR

PROPOSED CANOPY

Report No: 881

May, 2001

**ROY HARRISON
& ASSOCIATES
CONSULTING ENGINEERS**

EXAMPLE

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REF.:	C881	PAGE:	
DESIGN:	SCH	DATE:	13-May-01

TITLE :

Doubly Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

Doubly Pitched Canopy

Alpha	11.0 degrees =	0.19 radians =	Pitch 1 in 5.14
Building Eaves Hght	2.7 m	Building Span	9 m
Bay Spacing	3 m	Number of Bays	3
Building Length	9 m		

Region	A	Vp =	41 m/s	Vs =	38 m/s
Location	: Adelaide	Vu =	50 m/s	sensitive	NO: (static analysis acceptable)
b/d =	1.00	d/b =	1.00	h/d =	0.30

Q = 0

Wind Classification to AS1170
a < 60 h = he = 2.700 m

Tcat	3 TC3.0
M[z,cat] =	0.75
M[s] =	1 NS
M[t] =	1 T1
M[i] =	1
directional M[d] =	1

	Perm	Limit
Vz =	30.8	37.5 m/s
qz =	0.57	0.84 kPa

Q = 90

Wind Classification to AS1170
h = ht = 3.575 m

Tcat	3 TC3.0
M[z,cat] =	0.75
M[s] =	1 NS
M[t] =	1 T1
M[i] =	1
M[d] =	1

	Perm	Limit
Vz =	30.8	37.5 m/s
qz =	0.57	0.84 kPa

Wind Classification to AS4055
N2 WP33,WU40

Vz =	33	40 m/s
qz =	0.65	0.96 kPa

Wind Classification to AS4055
N2 WP33,WU40

Vz =	33	40 m/s
qz =	0.65	0.96 kPa

Design	AS1170	Limit State
Vz =	37.5 m/s	
qz =	0.84 kPa	
wz =	2.53 kN/m	

Design	AS1170	Limit State
Vz =	37.5 m/s	
qz =	0.84 kPa	
wz =	2.53 kN/m	

b =	9.00 m	d =	9.00 m
local pressure extent = 'a' =	min	$\begin{matrix} 0.2 b \\ 0.2 d \\ ht \end{matrix}$	= 1.8 m
a/2 =	0.9 m		
Length along Slope of Rafter =	4.584 m		

Area Reduction Factors

Rafter	
Aligned	4.584 x 3.000 =
Projected	4.500 x 3.000 =
Column	
Aligned	2.700 x 3.000 =

Tributary Area

m ²	Ka
13.75	0.97
13.50	0.98
8.10	1.00

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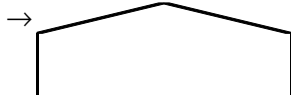
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TITLE :

Doubly Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

Doubly Pitched Canopy

Q = 0 Transverse



a < 60 h = he = 2.700 m
length b = 9.000 m
span d = 9.000 m
h/d = 0.30
d/h = 3.33
d/b = 1.00

State : Blocked Under

a = 11.0	-ve	+ve
Cpw =	-1.2	
Cpl =	-1.3	

Q = 180

State : Blocked Under

a = 11.0	-ve	+ve
Cpw =	-1.2	
Cpl =	-1.3	

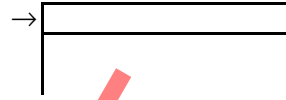
Frictional Drag on Roof

F1 = 0.01 bd qz

√ F1 = smooth/parallel to ribs 0.68 kN
2F1 = across corrugations 1.37 kN
4F1 = across ribs 2.73 kN

Doubly Pitched Canopy

Q = 90 Longitudinal



h = ht = 3.575 m
span b = 9.000 m
length d = 9.000 m
h/d = 0.40
d/h = 2.52
d/b = 1.00

State : Blocked Under

a = 0	-ve	+ve
Cpw =	-1.0	0.4
Cpl =	-0.8	0.4

Frictional Drag on Roof

F1 = 0.01 bd qz

F1 = smooth/parallel to ribs 0.68 kN
2F1 = across corrugations 1.37 kN
√ 4F1 = across ribs 2.73 kN

Drag on Frame

Assume :

125.00 SHS column	Cd	1.30
125.00 Channel Rafter		1.90

ki ksh

1.00	1.00
------	------

Fd = ki ksh kar Cd Az qz

	l/b	Kar	Az	Fd
			m ²	kN
Column	28.6	0.90	0.45	0.44
Rafter	36.7	1.00	0.57	0.92
			Σ	1.36

Wind on Gable End {if present}

Cpw = 0.7
Cpl = -0.5
Cpn = 1.2

Full Rise of Roof = 0.875 m
Area of Gable = 3.94 m²

Uplift

= bd Cpn qz
Total = 88.8 kN
14.8 kN/column

Uplift

= bd Cpn qz
Total = 68.3 kN
11.4 kN/column

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Doubly Pitched Canopy

Pressure Coefficients						
		Cpw	Cpl			
		2	3	Ka[roof]	qz [kPa]	wz[kN/m]
1	WL1 θ=0	-1.20	-1.30	0.98	0.84	2.53
3	WL3 θ=90	-1.00	-1.00	0.98	0.84	2.53

Pressures				+ve ↑→	
		roof p2 [kPa]	roof p3 [kPa]		
1	WL1 θ=0	0.99	1.07	{Cpe . qz . ka}	
3	WL3 θ=90	0.82	0.82	{Cpe . qz . ka}	

Loadings				+ve ↑→		Ridge P [kN]
		roof w2 [kN/m]	roof w3 [kN/m]			
DL = G						
LL = Q						
PL						
1	WL1 θ=0	2.97	3.21			
3	WL3 θ=90	2.47	2.47			

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ROOF CLADDING {Permissible Stress Design}	Cpe_0	1.30
Wind Pressures	Cpi	0.00
	Cpe_90	1.00

dwe = distance from windward edge a = local pressure extent

END WIND qz = 0.65[kPa] {theta = 90}

		Cpn	qz		
{ dwe ≤ 0.900 m = a/2 }	2	x	0.65[kPa]	=	1.30[kPa] ↑
{ dwe ≤ 1.800 m = a }	1.5	x	0.65[kPa]	=	0.98[kPa] ↑
{ dwe > 1.800 m = a }	1	x	0.65[kPa]	=	0.65[kPa] ↑

SIDE WIND qz = 0.65[kPa] {theta = 0}

		Cpn	qz		
{ dwe ≤ 0.900 m = a/2 }	2.6	x	0.65[kPa]	=	1.69[kPa] ↑
{ dwe ≤ 1.800 m = a }	1.95	x	0.65[kPa]	=	1.27[kPa] ↑
{ dwe > 1.800 m = a }	1.3	x	0.65[kPa]	=	0.85[kPa] ↑

	Wind kPa	Sheeting kPa	Resultant kPa
End	1.69	-0.04	1.65 ↑ok
Internal	0.85	-0.04	0.81 ↑ok

ADOPT :	ROOF CLADDING
Custom Orb	0.47 TCT minimum slope 5 degrees
Number of Fasteners per Sheet	3
No. 12 x 35mm Hex Head self-drilling tapping screw	
Sheeting END Spans	1.8 kPa 900 mm max
Sheeting INTERNAL Spans	1.7 kPa 1200 mm max

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Doubly Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

Reference AS1170.2 - 1989 SAA LOADING CODE

WIND LOADS - Determination of UDL's equivalent to Local Loadings for Simple Supports

ROOF PURLINS

'a'/2 local area extent		kl= 2.0
WIND	1.30	
→	↑↑↑↑↑↑	1.30+0.00
θ=0°	↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑	

'a' local area extent		kl= 1.5
WIND	1.30/2	
→	↑↑↑↑↑↑	1.30+0.00
θ=0°	↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑	

L {span}	a	b {'a'/2}	x1	L-x1
dist.	3	1.05	0.9	1.50
dist ²	9.00	1.10	0.81	

a	b {'a'}	x1	L-x1
0.60	1.8	1.50	1.50
0.36	3.24		

	kN/m	kN
w1 full	1.30	3.90
w2 partial	1.30	1.17
Σ =	2.60	5.07

	kN/m	kN
	1.30	3.90
	0.65	1.17
Σ =	1.95	5.07

Partial Load Occuring At Centre of Span	Moment	End Reactions	
	M[max]	Ra	Rb
	kNm	kN	kN
full	1.46	1.95	1.95
partial at Centre	↑↑↑	0.75	0.59
Σ =	2.21	2.54	2.54
Equiv UDL :	Cp_n	1.96	

Moment	End Reactions		
	M[max]	Ra	Rb
	kNm	kN	kN
	1.46	1.95	1.95
	0.61	0.59	0.59
	2.08	2.54	2.54
	1.85		

Partial Load Occuring At End of Span	Moment	End Reactions	
	M[max]	Ra	Rb
	kNm	kN	kN
full	1.46	1.95	1.95
partial at end	↑↑↑	0.38	0.99
Σ =	1.84	2.94	2.13
Equiv UDL :	Cp_n =	1.64	

Moment	End Reactions		
	M[max]	Ra	Rb
	kNm	kN	kN
	1.46	1.95	1.95
	0.52	0.82	0.35
	1.98	2.77	2.30
	1.76		

MAX Equiv UDL :	Cp_n =	1.64
-----------------	--------	------

	1.76
--	------

'a'/2 local area extent		kl= 2.0
WIND	1.00	
→	↑↑↑↑↑↑	1.00+0.0
θ=90°	↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑	

'a' local area extent		kl= 1.5
WIND	1.0/2	
→	↑↑↑↑↑↑	1.00+0.0
θ=90°	↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑	

	kN/m	kN
w1 full	1.00	3
w2 partial	1	0.90
Σ =	2.00	3.90

	kN/m	kN
	1.00	3
	0.5	0.9
Σ =	1.50	3.90

Partial Load Occuring At End of Span	Moment	End Reactions	
	M[max]	Ra	Rb
	kNm	kN	kN
full	1.13	1.50	1.50
partial at end	↑↑↑	0.29	0.77
Σ =	1.42	2.27	1.64
Equiv UDL :	Cp_n =	1.26	

Moment	End Reactions		
	M[max]	Ra	Rb
	kNm	kN	kN
	1.13	1.50	1.50
	0.40	0.63	0.27
	1.52	2.13	1.77
	1.35		

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Doubly Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

span = 3000 Int = 1200 c/c
 Edge = 900 c/c

PURLINS

Limit State

Wind Pressures

dwe = distance from windward edge a = local pressure extent

END WIND

qz = 0.98[kPa] {theta = 90}

		Cpn		qz	=		
{ dwe ≤ 0.900 m = a/2 }	1.26	x	0.98[kPa]	=	1.23[kPa]	↑	
{ dwe ≤ 1.800 m = a }	1.35	x	0.98[kPa]	=	1.33[kPa]	↑	
{ dwe > 1.800 m = a }	1.00	x	0.98[kPa]	=	0.98[kPa]	↑	

SIDE WIND

qz = 0.96[kPa] {theta = 0}

		Cpn		qz	=		
{ dwe ≤ 0.900 m = a/2 }	1.64	x	0.96[kPa]	=	1.57[kPa]	↑	
{ dwe ≤ 1.800 m = a }	1.76	x	0.96[kPa]	=	1.69[kPa]	↑	
{ dwe > 1.800 m = a }	1.30	x	0.96[kPa]	=	1.25[kPa]	↑	

Forces	+ ↑	- ↓
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	Spacing m	Area m ²	Wind kPa	Live Load kPa	Sheeting kPa	Purlin swt kN/m	Resultant kN/m	Stress Ratio
Internal	Inwards	1.200	3.60	-0.62	-0.04	-0.01	-1.19	1
	Outwards	1.200	0.98		-0.04	-0.01	1.13	
Edge	Inwards	0.900	2.70	-0.79	-0.04	-0.01	-1.12	
	Outwards	0.900	1.23		-0.04	-0.01	1.07	

Trial	50x50x2 SHS		
	Inwards	Outwards	
capacity	2.66	2.66 kNm	from Duragal DCT
applied	1.34	1.27 kNm	ss moment
load factor	1.98	2.10	
	ok	ok	
Combined Assessment	ok		
SHS not subject to flexural lateral distortion			

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ADOPT :	PURLINS
Duragal	50x50x2 SHS
	@ 3,000 mm Span
	@ 1,200 c/c Spacing in General
	@ 900 c/c Spacing at Edges
	welded between rafters

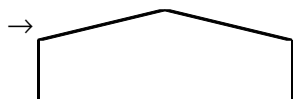
Axial Reserve Eaves and Ridge kN simplified procedure BHP Safe Load Tables

TITLE :

Doubly Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

Doubly Pitched Canopy

Q = 0 Transverse



REFER TO FRAME ANALYSIS

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Total Moment Base of Column = 6.23 kNm

Base Connection

lever arm	=	145 mm
Total Number of Bolts	=	4 total
Bolt Tension	=	42.9 kN/bolt plane
	=	21.5 kN/bolt
M16-4.6/s	phi . Ntf =	50.2 kN/bolt
	phi . Vfn =	28.6 kN/bolt
Plate Strength	=	250 MPa
Plate Thickness	=	12 mm
Plate length	=	200 mm
Plate Width	b =	200 mm
Bolt dist.	=	35 mm
phi	=	0.9

Applied Plate Moment = 0.75 kNm
 allowing for double curvature

Plate Modulus = 5.760E+04 mm³
 Plate Capacity = 12.96 kNm

applied 0.75 < capacity 12.96 kNm ok

Doubly Pitched Canopy

Q = 90 Longitudinal



Column Check

Drag load on all Roof one bay		2.73 kN
		0.91 kN
Drag load Rafters	2	1.84 kN
Total Load at Roof Level		<u>2.75 kN</u>
Average Height = (he + ht)/2		3.14 m
Resultant Moment		<u>8.62 kNm</u>
Drag on Columns	2	0.88 kN
Height of Application		1.35 m
Resultant Moment		<u>1.19 kNm</u>
Total Moment Base of Column		<u>9.81 kNm</u>

M* <= phi Msy phi = 0.9
 ∴ Trial : **125 x 75 x 4.0 RHS DuraGal**

applied 9.81 < capacity 15.1 kNm ok

Base Connection (check)

lever arm	=	145 mm
Total Number of Bolts	=	4 total
Bolt Tension	=	67.7 kN/bolt plane
	=	33.8 kN/bolt
M16-4.6/s	phi . Ntf =	50.2 kN/bolt
	phi . Vfn =	28.6 kN/bolt
Plate Strength	=	250 MPa
Plate Thickness	=	12 mm
Plate length	b =	200 mm
Plate Width	=	200 mm
Bolt dist.	=	35 mm
phi	=	0.9

Applied Plate Moment = 1.18 kNm
 allowing for double curvature

Plate Modulus = 5.760E+04 mm³
 Plate Capacity = 12.96 kNm

applied 1.18 < capacity 12.96 kNm ok

ADOPT: Base Connection
 4M16-4.6/s Hold Down Bolts
 200 x 200 x 12 PL

TITLE :

Doubly Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

PIERS FOR COLUMNS

ASSUME SANDY SOIL				Density	kg/m ³	kN/m ³
active	0.27	Total cone height {D+f}	1.43	Soil	1937.00	19.00
passive	3.69	Cone Vol {V_tot}	1.50	Concrete	2400.00	23.54
soil cone {e}	0.70	Apex vol {v2}	0.04			
apex length {x}	0.43	Cylinder vol {v_cyl}	0.28			
diameter {f}	2.00	γ =	1900 kN/m ³			
		c =	0.00 kPa			
		φ =	35			
			0.61 radians			
allowable bearing		pmax =	100.00 kPa			

DL load factor = 0.80
 Overturning Factor = 1.40
 Diameter d = 0.6
 Depth D = 1
 Vu = 14.8
 Vd = 0

Check Up Lift

	Volume [m ³]	Force [kN]
Soil	1.17	22.30
Concrete	0.28	6.66
cohes		0.00
DL Vd		0.00
Σ		28.95 kN

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FoS = $0.80 \times 28.95 / 14.80 = 1.57 > 1.40$ ok

Check Over Turning

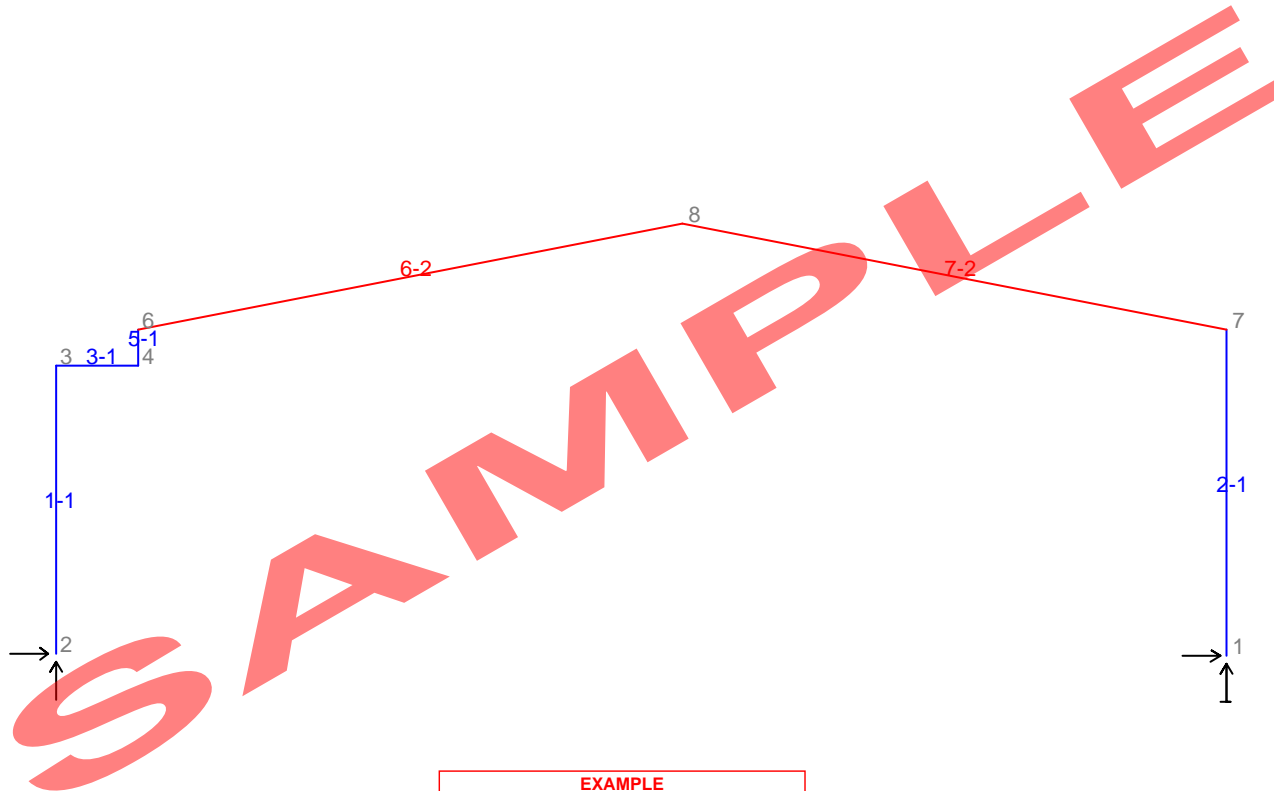
h = Mo / Ho = $6.23 / 7.22 = 0.86$ m P = Ho = 7.22
 Q2 = $P(10h + 3.4D) / (5.6 D)$ Mo = 6.226
 = $7.22 \times (10 \times 0.86 + 3.4 \times 1.00) / (5.6 \times 1.00)$
 = 15.50 kN
 Q1 = Q2 + P = 22.72 kN
 S1 = $22.7 / (0.68 \times 1.00 \times 0.60) = 55.69 \Rightarrow$ p average

pa = $1.5 \times 55.69 = 83.53 < pmax$ ok

ADOPT : 600 DIAM. PIER x 1000 DEEP

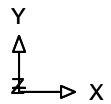
Sections:

- 1 125X75X4.0RHS Y
- 2 125X75X4.0RHS Y



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Frame Geometry

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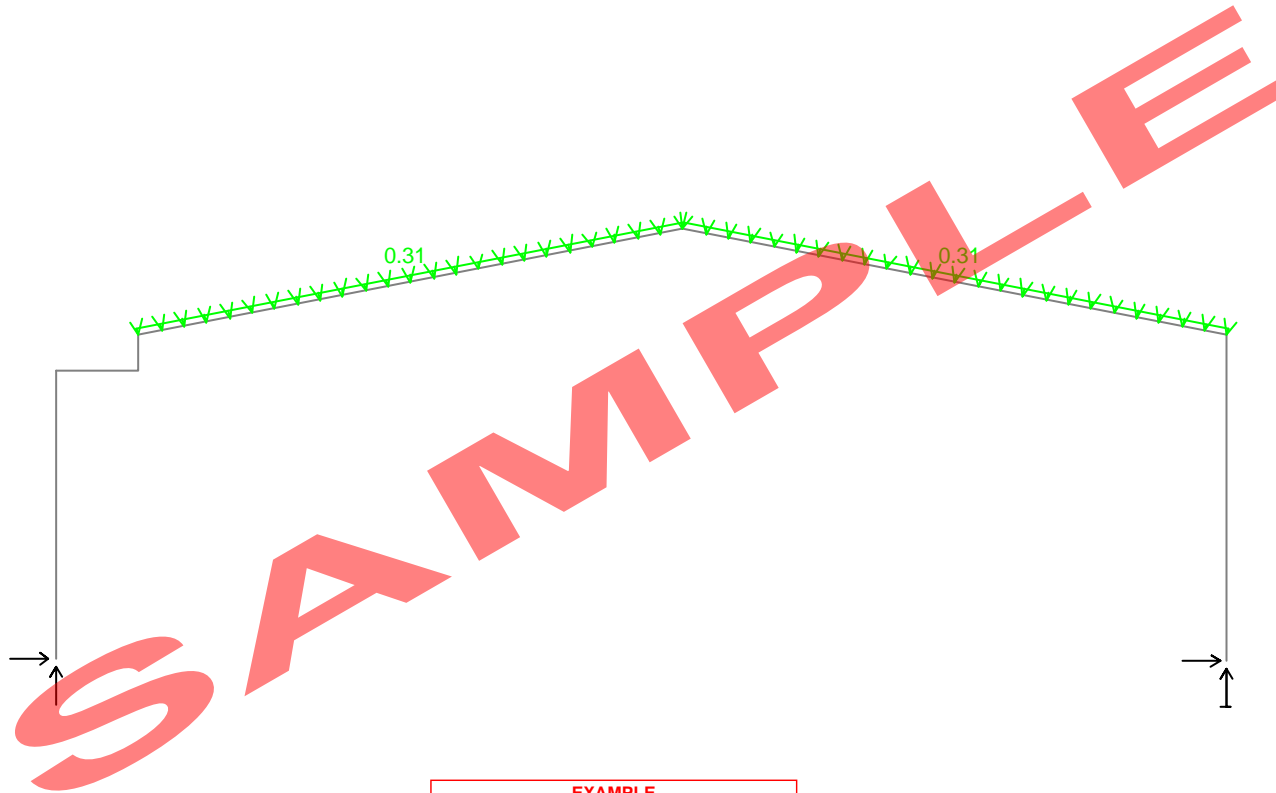
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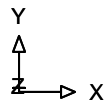
Load Cases:

— 20 P DEADLOADS {DL}



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theta: 270 phi: -5

Gravity Loads : DeadLoads

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Job: c881d

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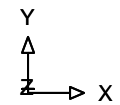
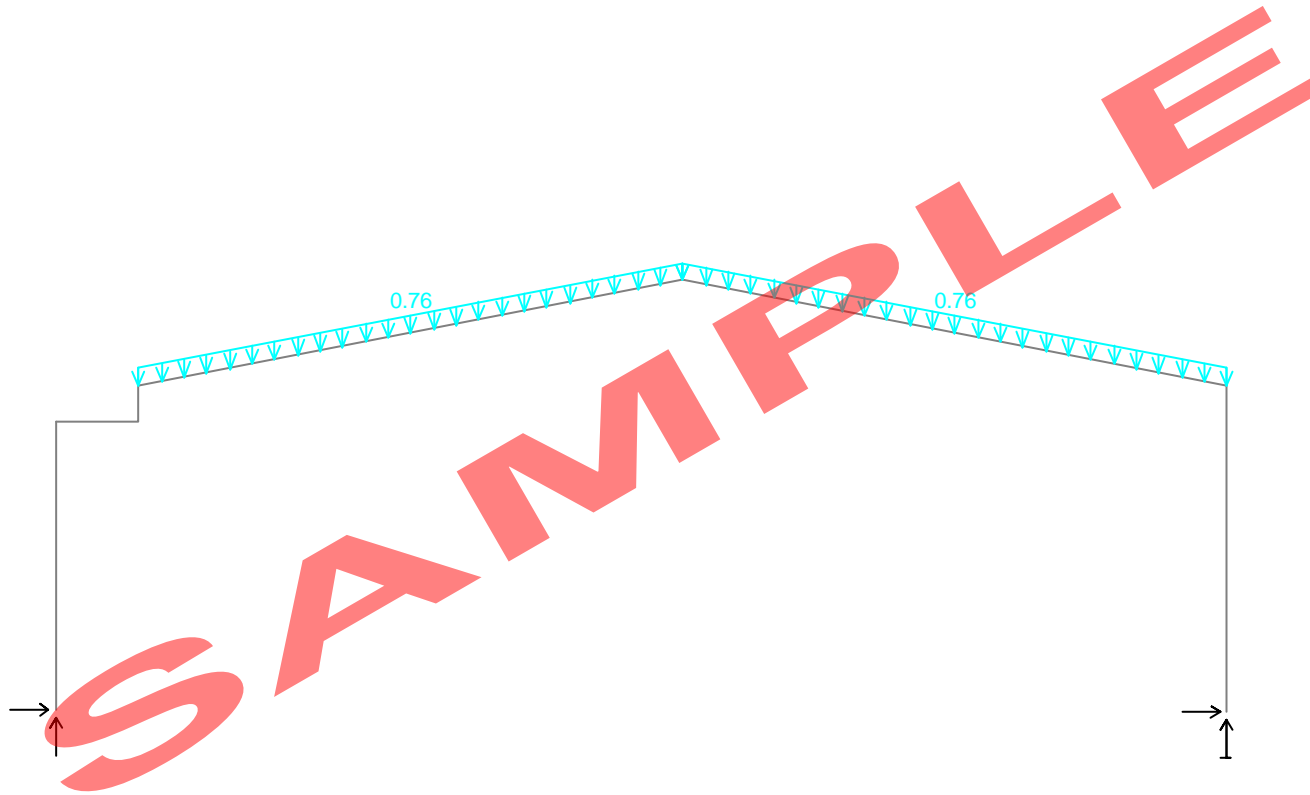
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Load Cases:

— 30 P LIVE LOAD {LL}



theta: 270 phi: -5

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Gravity Loads : LiveLoads

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Job: c881d

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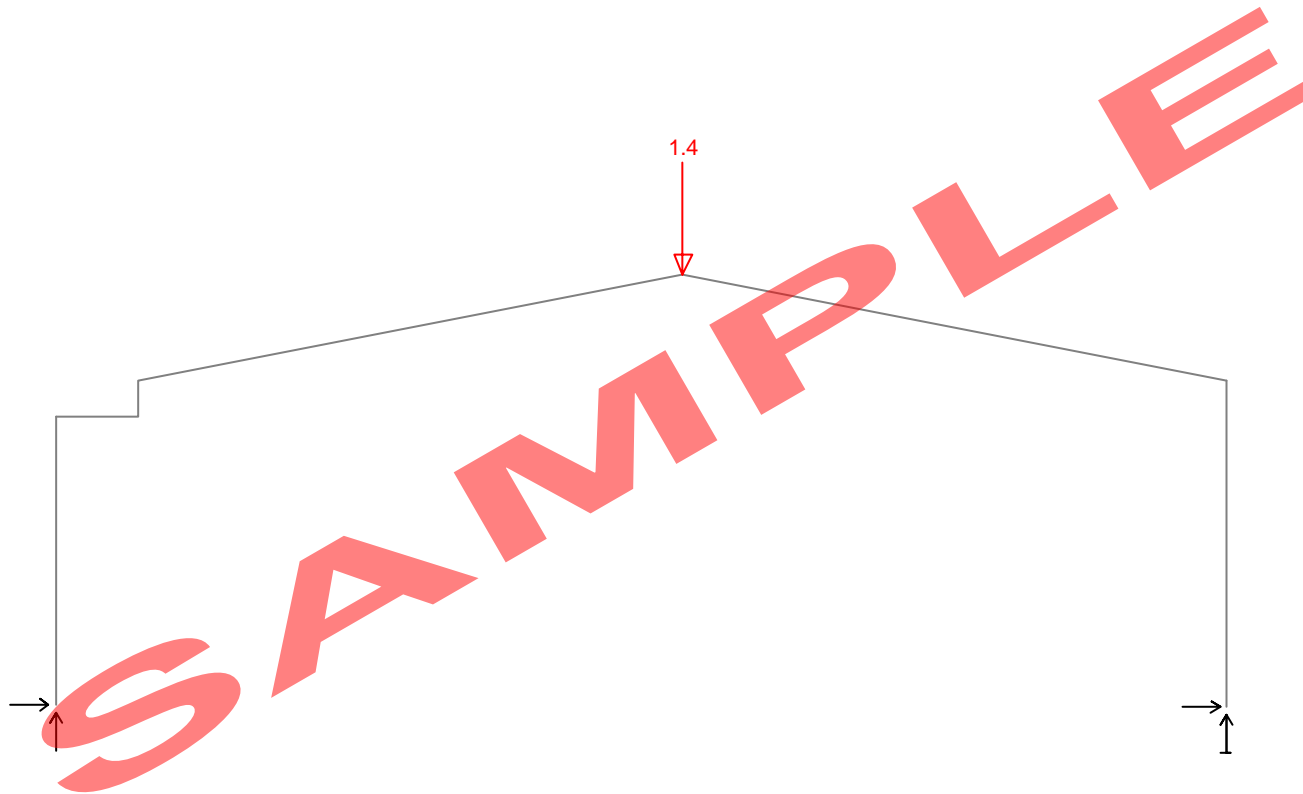
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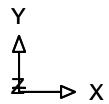
04:42 PM

Load Cases:

— 40 P OCCASIONAL POINT LOAD {PL}



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theta: 270 phi: -5

Gravity Loads : Occasional Point

Roy Harrison & Associates

Job: c881d

C881: Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

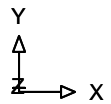
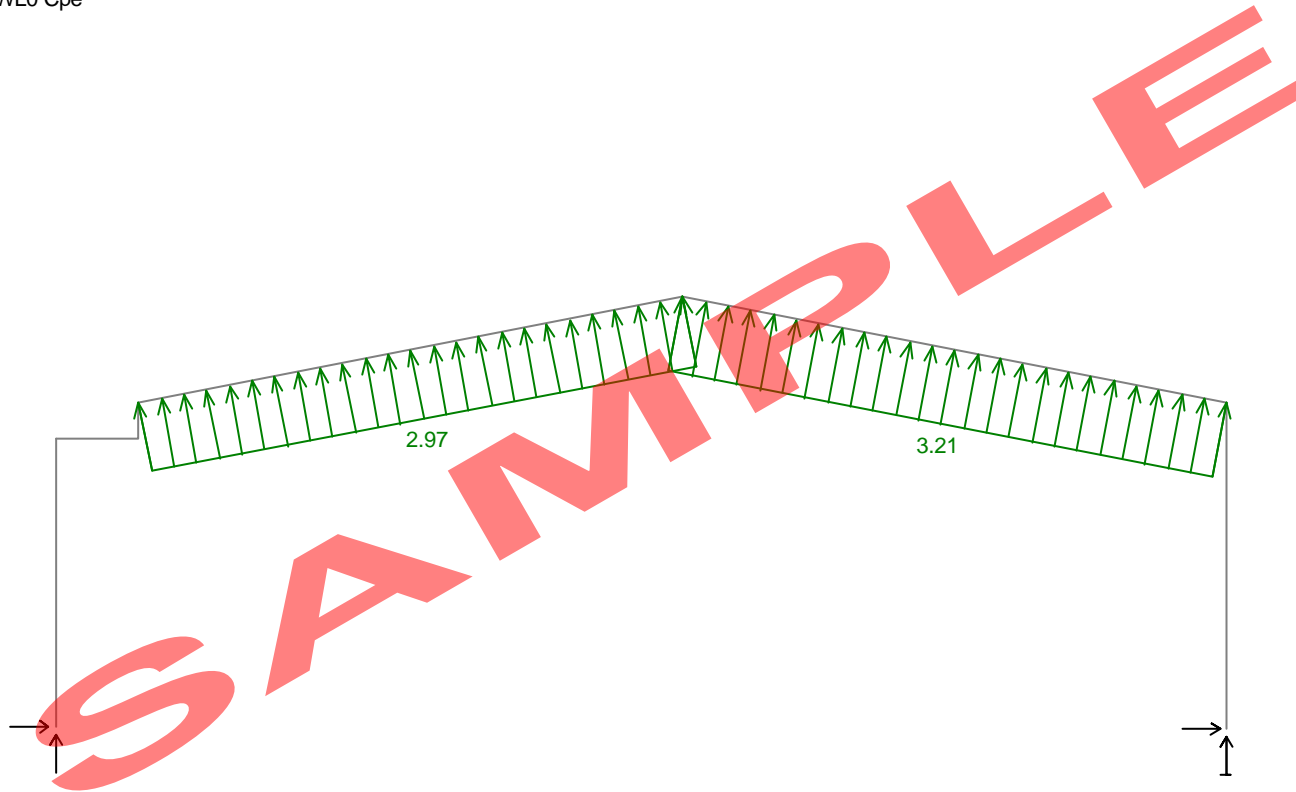
SCH

20 May 2001

04:43 PM

Load Cases:

— 1210 P WINDLOAD $WLe[1,1]=WL0$ Cpe



theta: 270 phi: -5

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Wind Load : Theta 0

Roy Harrison & Associates

Job: c881d

C881: Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

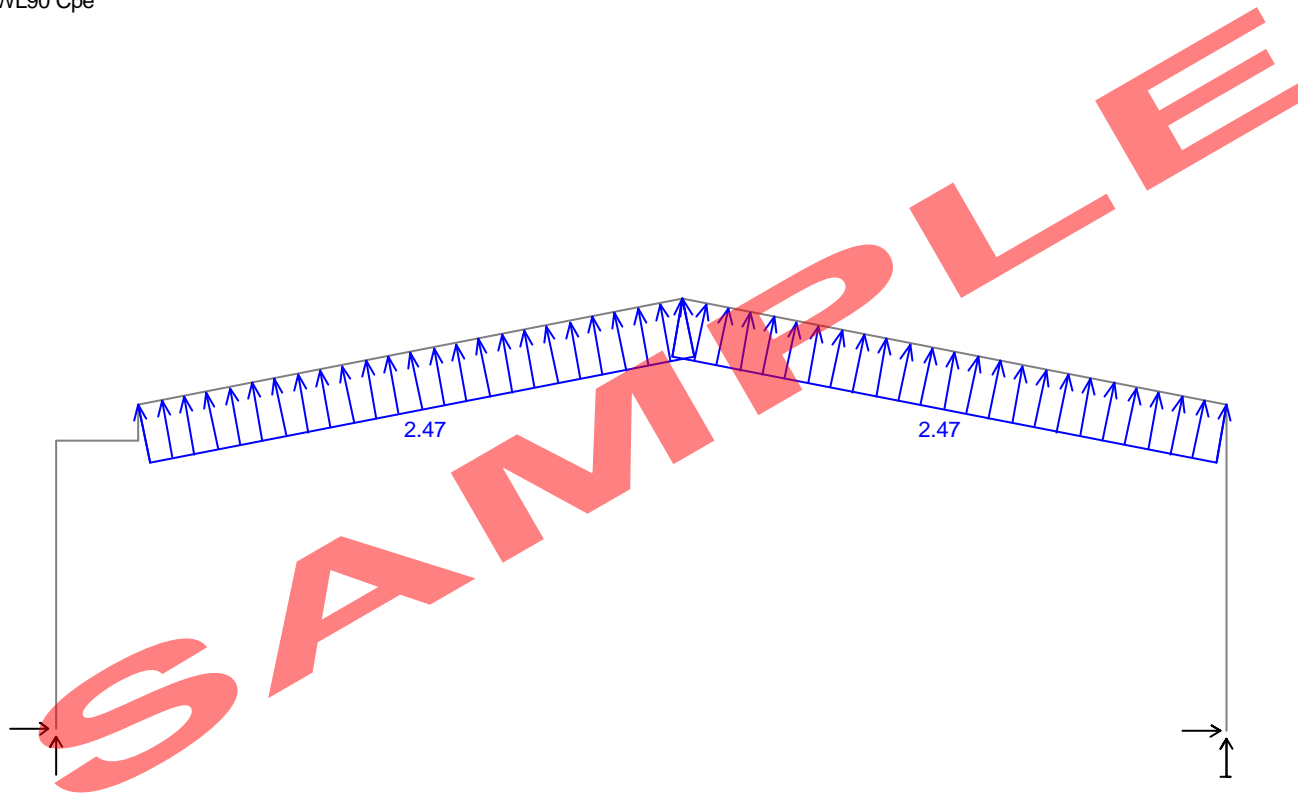
SCH

20 May 2001

04:44 PM

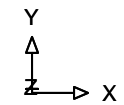
Load Cases:

— 1230 P WINDLOAD WLe[3,1]=WL90 Cpe



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theta: 270 phi: -5

Wind Load : Theta 90

Roy Harrison & Associates

Job: c881d

C881: Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

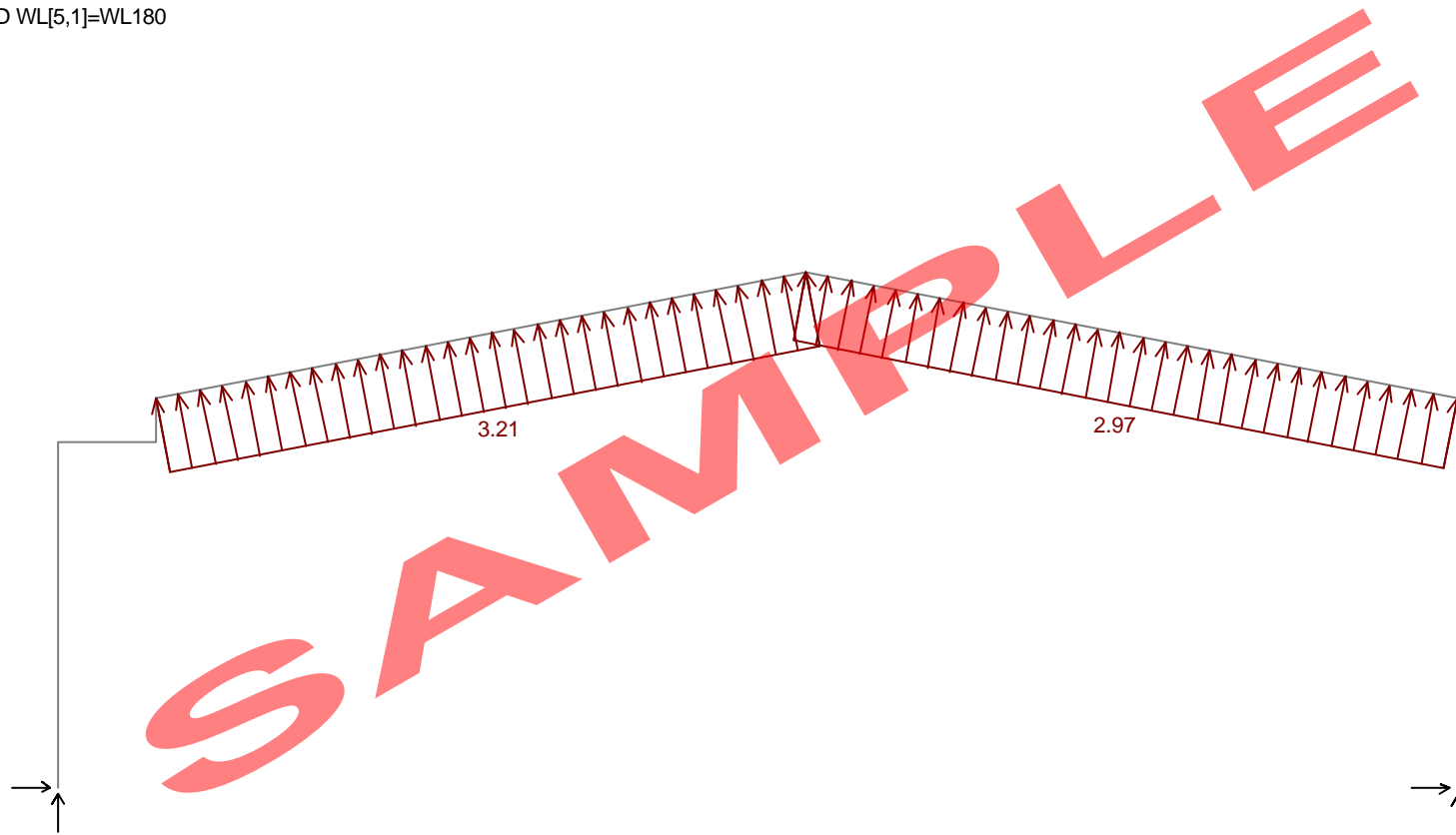
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20 May 2001

05:00 PM

Load Cases:

— 1250 P WINDLOAD WL[5,1]=WL180



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Y
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Z → X
theta: 270 phi: 0

WindLoads: Theta = 180

Roy Harrison & Associates

Job: c881d

C881: Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

SCH

20 May 2001

05:02 PM

Envelope for Axial Force

— Maximum

— Minimum

Enveloped Cases:

1000 C G = SWT+DL (gy=-9.81)

1030 C Q = LL + PL

2030 C G+LL

2040 C G+PL

2050 C G+Q

2210 C G+WL[1,1]

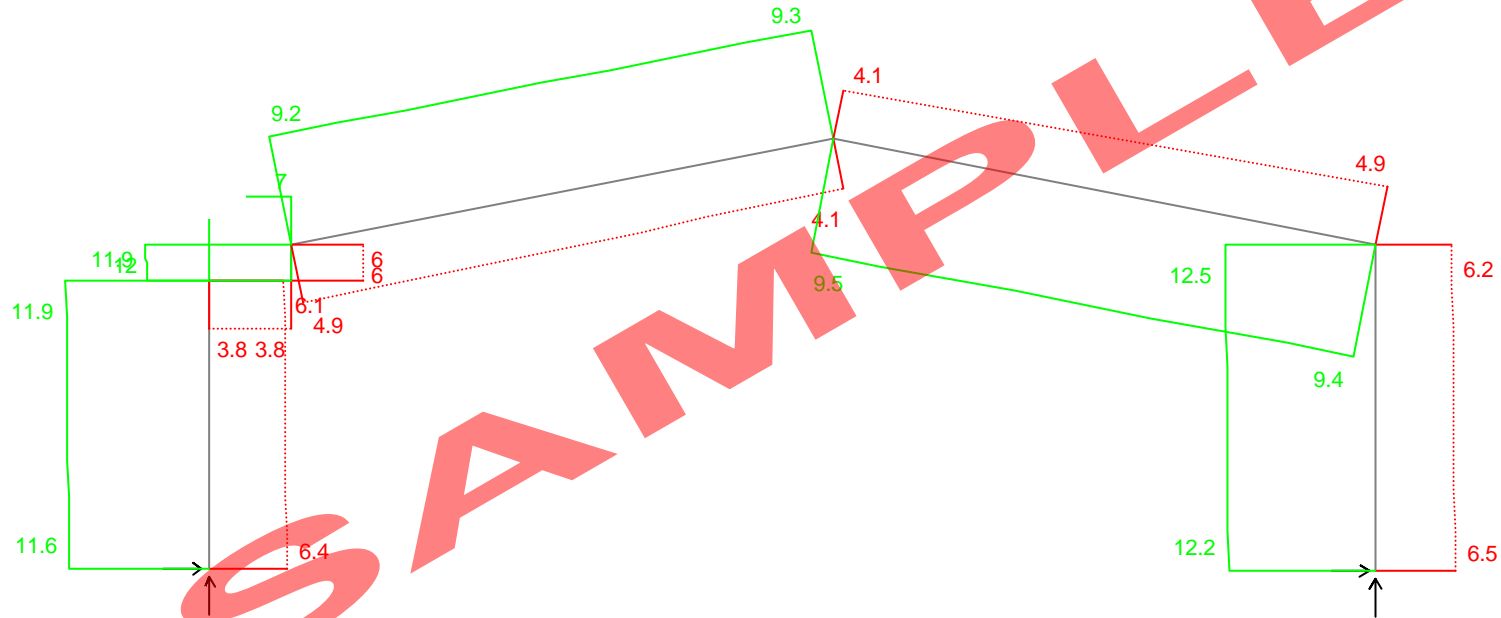
2230 C G+WL[3,1]

2250 C G+WL[5,1]

3210 C G+WL[1,1]

3230 C G+WL[3,1]

3250 C G+WL[5,1]



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Y
↑
Z → X
theta: 270 phi: 0

Design Envelope : Axial

Axial Force, Fx

Roy Harrison & Associates

Job: c881d

C881: Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

SCH

20 May 2001

05:02 PM

Envelope for Moment Mz

— Maximum

— Minimum

Enveloped Cases:

1000 C G = SWT+DL (gy=-9.81)

1030 C Q = LL + PL

2030 C G+LL

2040 C G+PL

2050 C G+Q

2210 C G+WL[1,1]

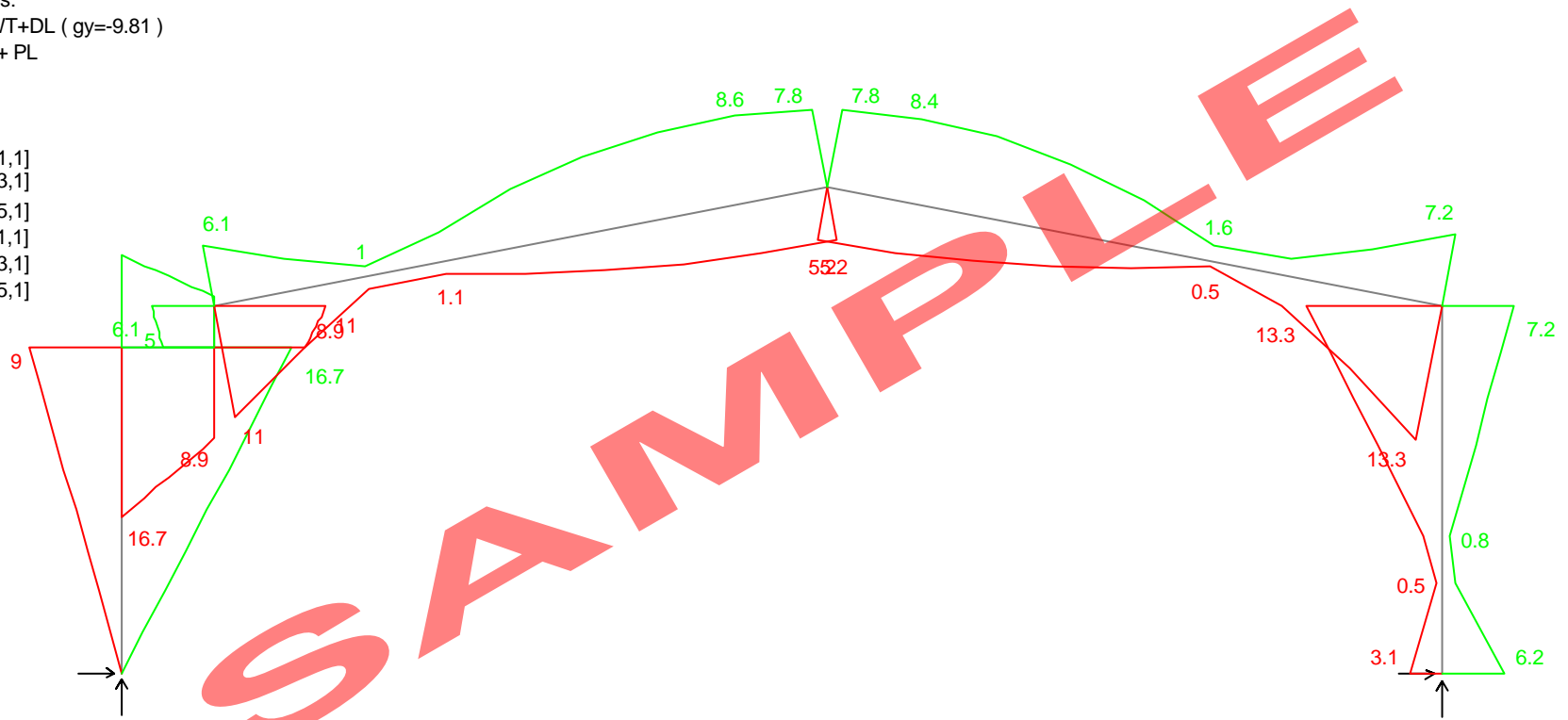
2230 C G+WL[3,1]

2250 C G+WL[5,1]

3210 C G+WL[1,1]

3230 C G+WL[3,1]

3250 C G+WL[5,1]



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Y
↑
Z → X
theta: 270 phi: 0

Design Envelope : Moments

Bending Moment, Mz

Roy Harrison & Associates

Job: c881d

C881: Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

SCH

20 May 2001

05:02 PM

Envelope for Shear Fy

— Maximum

— Minimum

Enveloped Cases:

1000 C G = SWT+DL (gy=-9.81)

1030 C Q = LL + PL

2030 C G+LL

2040 C G+PL

2050 C G+Q

2210 C G+WL[1,1]

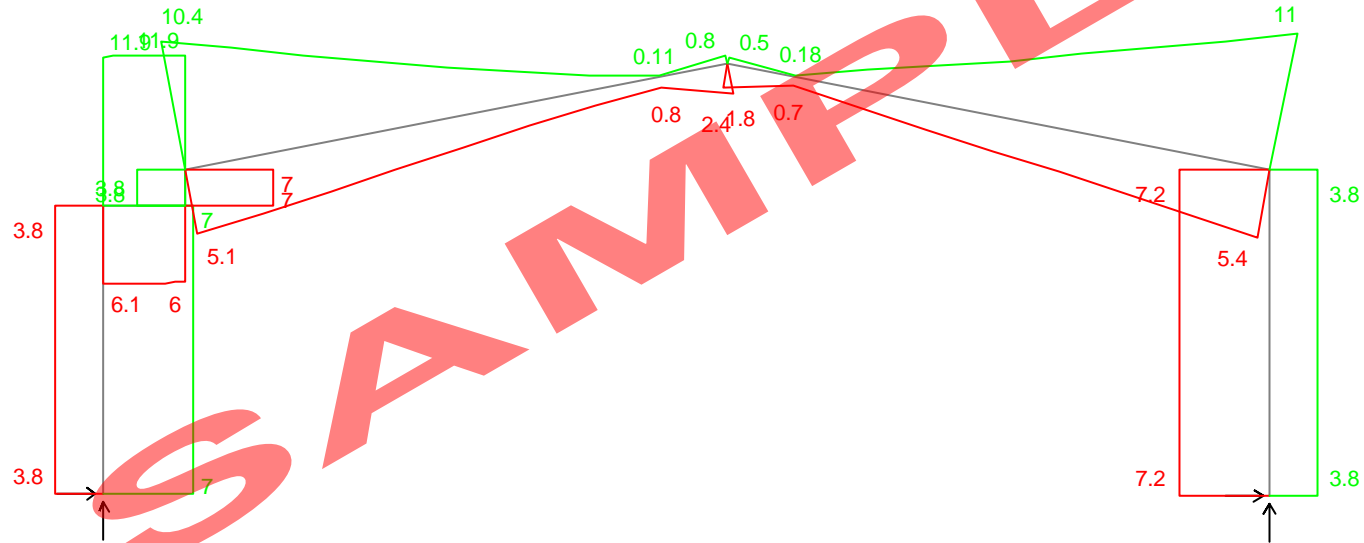
2230 C G+WL[3,1]

2250 C G+WL[5,1]

3210 C G+WL[1,1]

3230 C G+WL[3,1]

3250 C G+WL[5,1]



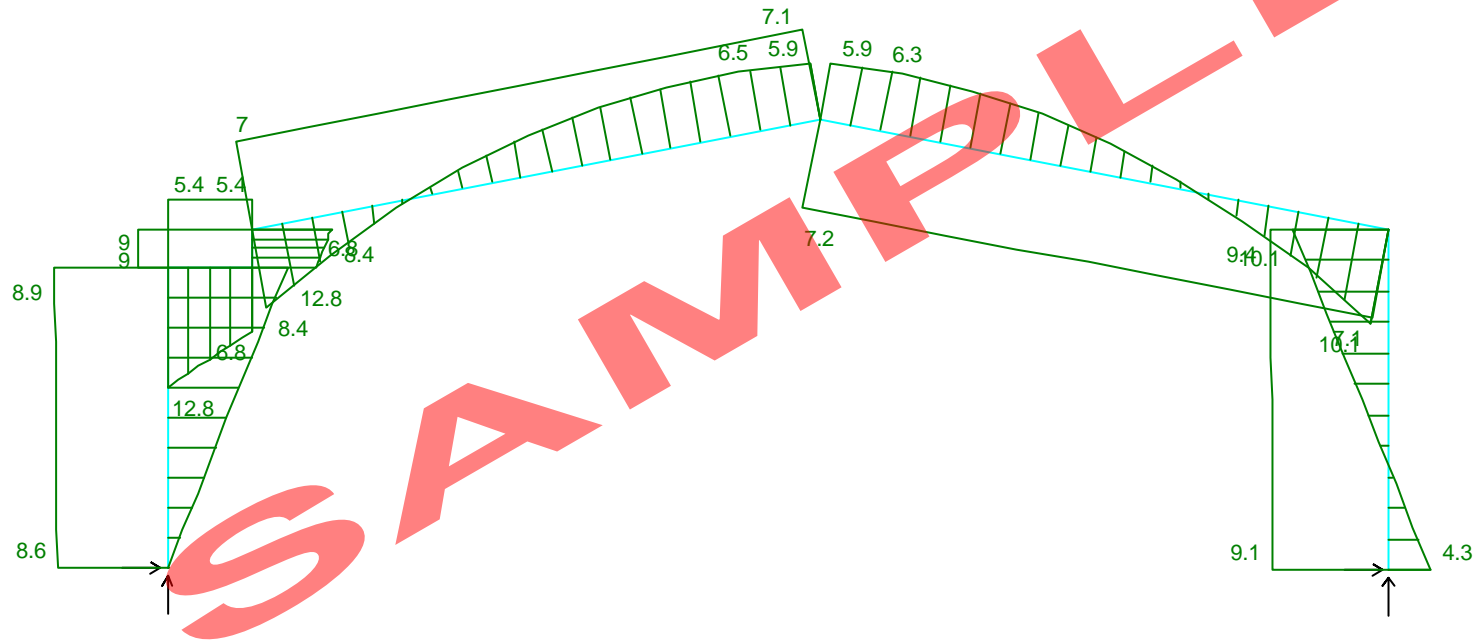
Y
↑
Z → X
theta: 270 phi: 0

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Design Envelope : Shear

Shear Force, Fy

Load Cases:
— 2230 C G+WL[3,1]



EXAMPLE

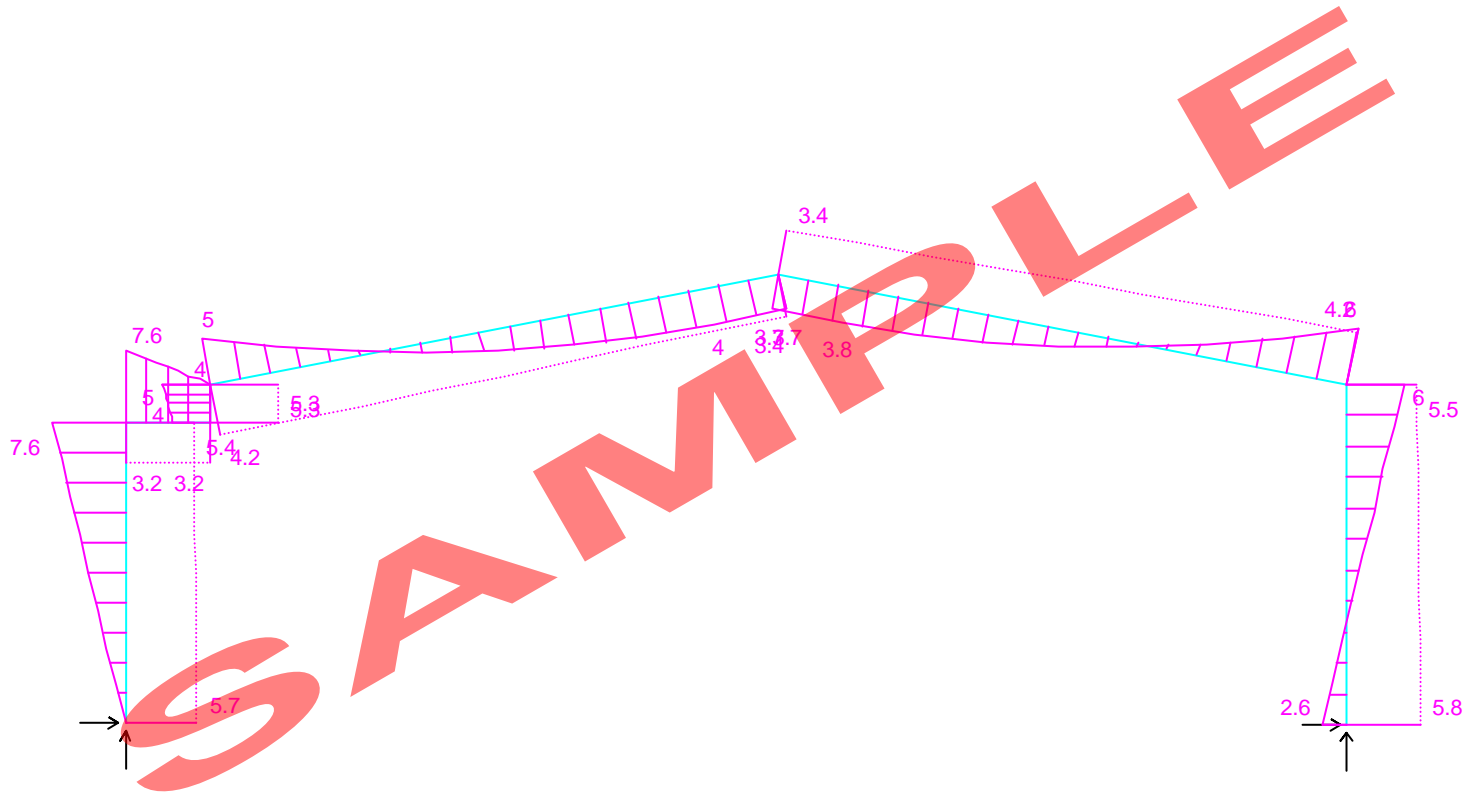
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Y
↑
Z → X
theta: 270 phi: 0

Wind Effects: Theta = 90

Axial Force, Fx
Bending Moment, Mz

Load Cases:
— 2030 C G+LL



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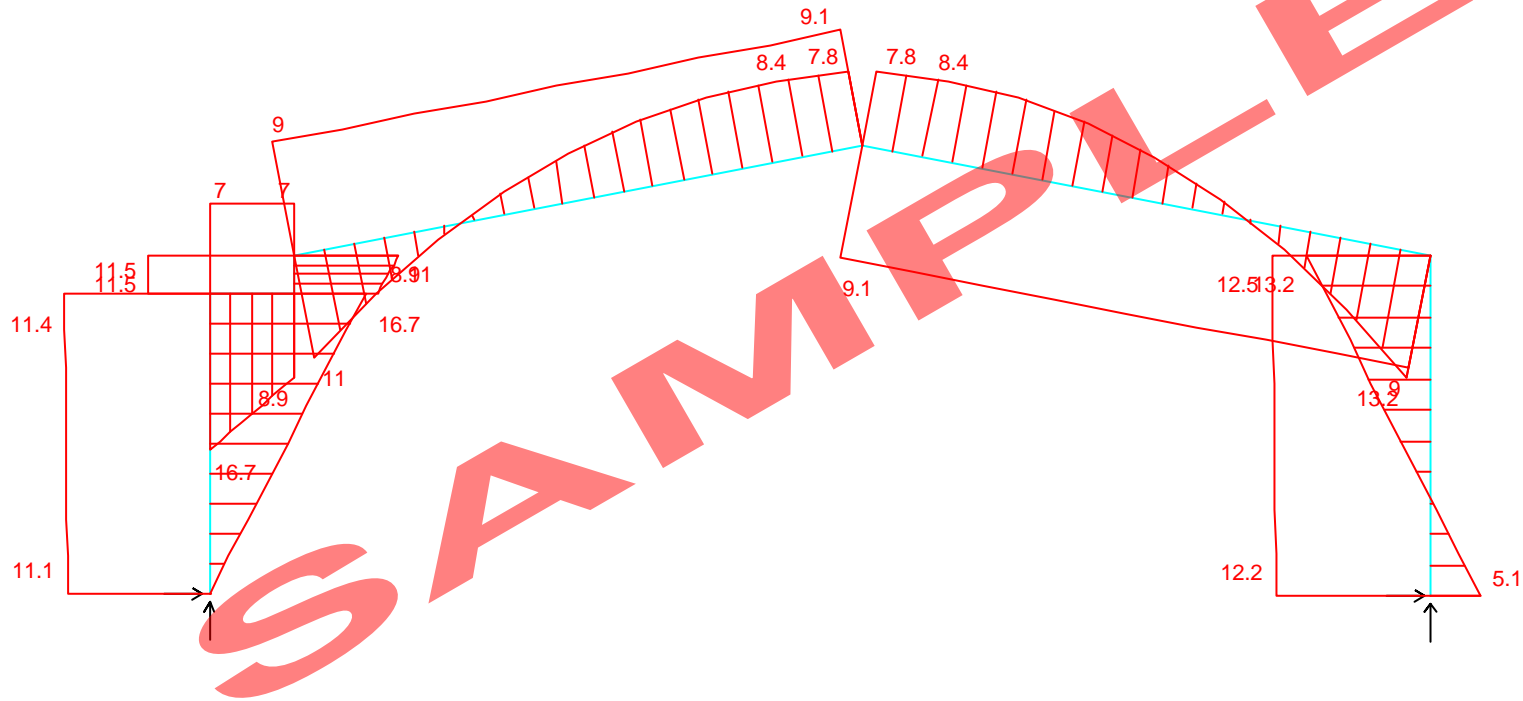
Gravity Effects

Axial Force, Fx
Bending Moment, Mz

Y
↑
Z → X
theta: 270 phi: 0

Load Cases:

— 2210 C G+WL[1,1]



EXAMPLE

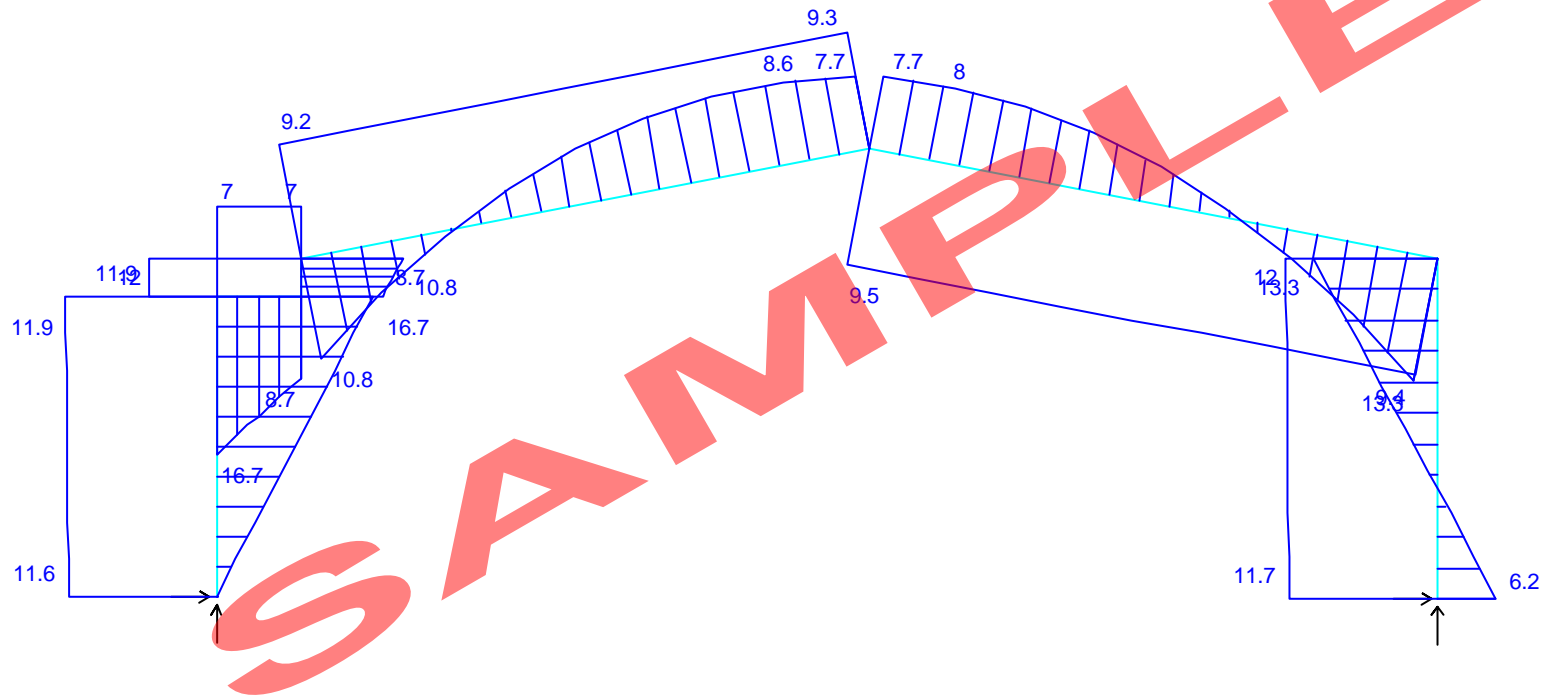
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Wind Effects: Theta = 0

Axial Force, Fx
Bending Moment, Mz

Load Cases:

— 2250 C G+WL[5,1]



Y
↑
Z → X
theta: 270 phi: 0

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Wind Effects: Theta = 180

Axial Force, Fx
Bending Moment, Mz

LOAD CASES - STEEL DESIGN

Case	Type	Title
1000	C	G = SWT+DL
1030	C	Q = LL + PL
2030	C	G+LL
2040	C	G+PL
2050	C	G+Q
2210	C	G+WL[1,1]
2230	C	G+WL[3,1]
2250	C	G+WL[5,1]
3210	C	G+WL[1,1]
3230	C	G+WL[3,1]
3250	C	G+WL[5,1]

STEEL MEMBERS SUMMARY REPORT

Memb	Code	Length mm	Grade	Section Name	Crit. Ratio	Load Case	Critical Condition
1	AS4100	2385	C350	125X75X4.0RHS	1.136	2250	Section N+Mx
2	AS4100	2700	C350	125X75X4.0RHS	1.432	2250	Section N+Mx
3	AS4100	675	C350	125X75X4.0RHS	1.136	2250	Section N+Mx
5	AS4100	300	C350	125X75X4.0RHS	1.721	2210	Section N+Mx
6	AS4100	4584	C350	125X75X4.0RHS	1.721	2210	Section N+Mx
7	AS4100	4584	C350	125X75X4.0RHS	1.432	2250	Section N+Mx

LOAD CASES - STEEL DESIGN

Case	Type	Title
1000	C	G = SWT+DL
1030	C	Q = LL + PL
2030	C	G+LL
2040	C	G+PL
2050	C	G+Q
2210	C	G+WL[1,1]
2230	C	G+WL[3,1]
<u>2250</u>	<u>C</u>	<u>G+WL[5,1]</u>
3210	C	G+WL[1,1]
3230	C	G+WL[3,1]
3250	C	G+WL[5,1]

STEEL MEMBERS FULL REPORT

MEMBER: 1 (Code Check to AS4100)

Section: 125X75X4.0RHS Axis: Y Grade: C350 fy: 350 fu: 430

column

Section dimensions and properties.

D=	125.0	B=	75.0	T=	4.0				
Ag=	1480.0	rx=	45.4	Zx=	4.89E+04	Sx=	6.03E+04		
		ry=	30.6	Zy=	3.70E+04	Sy=	4.24E+04		
		J=	3.16E+06	Iw=	0.00E+00				

Section Properties for Design:

Form Factor=	1.000	Class Mx: Compact	Zex=	6.030E+04
Ae=	1480	Class My: Non-compact	Zey=	3.991E+04

Member Restraints

No	Offset	Top	Btm	Cant	Ht	XX	kx	YY	ky
1	0.000	L	L	N	S	Y	1.00	Y	1.00
2	2.385	L	L	N					

Sidesway - about XX axis: N about YY axis: N

Critical conditions for design load cases:

Case	Cap/Load	Condition
1000	6.665	Member out-plane C+Mx
1030	2.882	Member out-plane C+Mx

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2030	2.375	Member out-plane C+Mx
2040	4.426	Member out-plane C+Mx
2050	2.012	Member out-plane C+Mx
2210	1.141	Section N+Mx
2230	1.485	Section N+Mx
2250	1.136	Section N+Mx
3210	2.240	Section N+Mx
3230	3.039	Section N+Mx
3250	2.229	Section N+Mx

column buckling

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SECTION CHECKS

Case: 2250 Off: 2385 Cap/Load= 1.136 Section N+Mx (8.3.2)

Design loads: N*= 11.86 t M*x= -16.72 M*y= 0.00
 Design capacities $\phi N_t = 466.20$ $\phi M_{sx} = 18.99$ $\phi M_{sy} = 12.57$
 $\phi N_s = 0.00$ $\phi M_{rx} = 18.99$ $\phi M_{ry} = 12.25$

MEMBER/SEGMENT CHECKS

Case: 2250 Off: 0/2385 Cap/Load= 1.136 Section N+Mx (8.3.2)

Design loads: N*= 11.86 t M*x= -16.72 M*y= 0.00
 Lmx= 2385 column o/a length $\beta_{mx} = 0.000$
 Lmy= 2385 $\beta_{my} = 0.000$
 Lx= 2385 $\beta_{me} = 0.000$
 Ly= 2385 $\alpha_m = 1.817$ BM modification factor
 Le= 2385 beam eff. length $\alpha_s = 1.00$ BM slend. reductn. factor
 Lz= 2385 torsion eff. length

Design capacities
 $\phi N_t = 466.20$ $\phi M_{sx} = 18.99$ $\phi M_{bx} = 18.99$ $\phi M_{ox} = 18.99$
 $\phi M_{rx} = 18.99$ $\phi M_{ix} = 0.00$ $\phi M_{bxo} = 0.00$
 $\phi M_{sy} = 12.57$ $\phi M_{iy} = 0.00$ $\phi N_{oz} = 0.00$
 $\phi M_{ry} = 12.25$ $\phi M_{cx} = 0.00$

SHEAR CHECKS (Appendix I excluded)

Case: 2250 Off: 2385 Cap/Load= 1.519 Section N+Mx (8.3.2)

Design loads: V*= 7.01
 Design capacities $\phi V_v = 140.04$ $\phi M_f = 11.43$

MEMBER: 2 (Code Check to AS4100)

Section: 125X75X4.0RHS Axis: Y Grade: C350 fy: 350 fu: 430

Column

Section dimensions and properties.

D= 125.0 B= 75.0 T= 4.0
 Ag= 1480.0 rx= 45.4 Zx= 4.89E+04 Sx= 6.03E+04
 ry= 30.6 Zy= 3.70E+04 Sy= 4.24E+04
 J= 3.16E+06 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 1.000 Class Mx: Compact Zex= 6.030E+04
 Ae= 1480 Class My: Non-compact Zey= 3.991E+04

Member Restraints

		/--Beam--/				/-----Column-----/				
No	Offset	Top	Btm	Cant	Ht	XX	kx	YY	ky	
1	0.000	L	L	N	S	Y	1.00	Y	1.00	
2	2.700	L	L	N						

Sidesway - about XX axis: N about YY axis: N

Critical conditions for design load cases:

Case	Cap/Load	Condition
1000	8.270	Member out-plane C+Mx
1030	3.553	Member out-plane C+Mx
2030	2.939	Member out-plane C+Mx
2040	5.460	Member out-plane C+Mx

Column Buckling

2050	2.485	Member out-plane C+Mx
2210	1.444	Section N+Mx
2230	1.875	Section N+Mx
2250	1.432	Section N+Mx
3210	2.834	Section N+Mx
3230	3.833	Section N+Mx
3250	2.806	Section N+Mx

SECTION CHECKS

Case: 2250 Off: 2700 Cap/Load= 1.432 Section N+Mx (8.3.2)

Design loads: N*= 12.00 t M*x= 13.27 M*y= 0.00
 Design capacities ϕN_t = 466.20 ϕM_{sx} = 18.99 ϕM_{sy} = 12.57
 ϕN_s = 0.00 ϕM_{rx} = 18.99 ϕM_{ry} = 12.25

MEMBER/SEGMENT CHECKS

Case: 2250 Off: 0/2700 Cap/Load= 1.432 Section N+Mx (8.3.2)

Design loads: N*= 12.00 t M*x= 13.27 M*y= 0.00
 Lmx= 2700 column o/a length β_{mx} = 0.469
 Lmy= 2700 β_{my} = 0.000
 Lx= 2700 β_{me} = 0.469
 Ly= 2700 α_m = 2.451 BM modification factor
 Le= 2700 beam eff. length α_s = 1.00 BM slend. reductn. factor
 Lz= 2700 torsion eff. length

Design capacities
 ϕN_t = 466.20 ϕM_{sx} = 18.99 ϕM_{bx} = 18.99 ϕM_{ox} = 18.99
 ϕM_{rx} = 18.99 ϕM_{ix} = 0.00 ϕM_{bxo} = 0.00
 ϕM_{sy} = 12.57 ϕM_{iy} = 0.00 ϕN_{oz} = 0.00
 ϕM_{ry} = 12.25 ϕM_{cx} = 0.00

SHEAR CHECKS (Appendix I excluded)

Case: 2250 Off: 0 Cap/Load= 24.502 Section N+Mx (8.3.2)

Design loads: V*= 7.22
 Design capacities ϕV_v = 176.90 ϕM_f = 11.43

MEMBER: 3 (Code Check to AS4100)

Section: 125X75X4.0RHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D= 125.0 B= 75.0 T= 4.0
 Ag= 1480.0 rx= 45.4 Zx= 4.89E+04 Sx= 6.03E+04
 ry= 30.6 Zy= 3.70E+04 Sy= 4.24E+04
 J= 3.16E+06 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 1.000 Class Mx: Compact Zex= 6.030E+04
 Ae= 1480 Class My: Non-compact Zey= 3.991E+04

Member Restraints

No	Offset	Top	Btm	Cant	Ht	XX	kx	YY	ky
1	0.000	L	L	N	S	Y	1.00	Y	1.00
2	0.675	L	L	N					

Sidesway - about XX axis: N about YY axis: N

Critical conditions for design load cases:

Case	Cap/Load	Condition
1000	6.887	Member out-plane C+Mx
1030	2.946	Member out-plane C+Mx
2030	2.441	Member out-plane C+Mx
2040	4.543	Member out-plane C+Mx
2050	2.064	Member out-plane C+Mx
2210	1.141	Section N+Mx

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2230 1.485 Section N+Mx
 2250 1.136 Section N+Mx
 3210 2.240 Section N+Mx
 3230 3.039 Section N+Mx
 3250 2.229 Section N+Mx

SECTION CHECKS

Case: 2250 Off: 0 Cap/Load= 1.136 Section N+Mx (8.3.2)

Design loads: N*= 7.01 t M*x= 16.72 M*y= 0.00
 Design capacities ϕN_t = 466.20 ϕM_{sx} = 18.99 ϕM_{sy} = 12.57
 ϕN_s = 0.00 ϕM_{rx} = 18.99 ϕM_{ry} = 12.38

MEMBER/SEGMENT CHECKS

Case: 2250 Off: 0/675 Cap/Load= 1.136 Section N+Mx (8.3.2)

Design loads: N*= 7.01 t M*x= 16.72 M*y= 0.00
 Lmx= 675 column o/a length β_{mx} = -0.520
 Lmy= 675 β_{my} = 0.000
 Lx= 675 β_{me} = -0.520
 Ly= 675 α_m = 1.280 BM modification factor
 Le= 675 beam eff. length α_s = 1.03 BM slend. reductn. factor
 Lz= 675 torsion eff. length

Design capacities
 ϕN_t = 466.20 ϕM_{sx} = 18.99 ϕM_{bx} = 18.99 ϕM_{ox} = 18.99
 ϕM_{rx} = 18.99 ϕM_{ix} = 0.00 ϕM_{bxo} = 0.00
 ϕM_{sy} = 12.57 ϕM_{iy} = 0.00 ϕN_{oz} = 0.00
 ϕM_{ry} = 12.38 ϕM_{cx} = 0.00

SHEAR CHECKS (Appendix I excluded)

Case: 2250 Off: 0 Cap/Load= 1.491 Section N+Mx (8.3.2)

Design loads: V*= 11.86
 Design capacities ϕV_v = 140.04 ϕM_f = 11.43

MEMBER: 5 (Code Check to AS4100)

Section: 125X75X4.0RHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D= 125.0 B= 75.0 T= 4.0
 Ag= 1480.0 rx= 45.4 Zx= 4.89E+04 Sx= 6.03E+04
 ry= 30.6 Zy= 3.70E+04 Sy= 4.24E+04
 J= 3.16E+06 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 1.000 Class Mx: Compact Zex= 6.030E+04
 Ae= 1480 Class My: Non-compact Zey= 3.991E+04

Member Restraints

No	Offset	/--Beam--/		Load		/-----Column-----/			
		Top	Btm	Cant	Ht	XX	kx	YY	ky
1	0.000	L	L	N	S	Y	1.00	Y	1.00
2	0.300	L	L	N					

Sidesway - about XX axis: N about YY axis: N

Critical conditions for design load cases:

Case	Cap/Load	Condition
1000	10.929	Section N+Mx
1030	4.357	Section N+Mx
2030	3.804	Section N+Mx
2040	6.683	Section N+Mx
2050	3.115	Section N+Mx
2210	1.721	Section N+Mx
2230	2.268	Section N+Mx
2250	1.760	Section N+Mx

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3210 3.364 Section N+Mx
 3230 4.624 Section N+Mx
 3250 3.451 Section N+Mx

SECTION CHECKS

Case: 2210 Off: 300 Cap/Load= 1.721 Section N+Mx (8.3.2)

Design loads: N*= 11.49 t M*x= 11.04 M*y= 0.00
 Design capacities øNt= 466.20 øMsx= 18.99 øMsy= 12.57
 øNs= 0.00 øMrx= 18.99 øMry= 12.26

MEMBER: 6 (Code Check to AS4100)

Section: 125X75X4.0RHS Axis: Y Grade: C350 fy: 350 fu: 430

Rafter

Section dimensions and properties.

D= 125.0 B= 75.0 T= 4.0
 Ag= 1480.0 rx= 45.4 Zx= 4.89E+04 Sx= 6.03E+04
 ry= 30.6 Zy= 3.70E+04 Sy= 4.24E+04
 J= 3.16E+06 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 1.000 Class Mx: Compact Zex= 6.030E+04
 Ae= 1480 Class My: Non-compact Zey= 3.991E+04

Member Restraints

No	Offset	Top	Btm	Cant	Ht	XX	kx	YY	ky
1	0.000	L	L	N	S	Y	1.00	Y	1.00
2	1.200	L	N		S				
3	2.400	L	N		S				
4	3.600	L	N		S				
5	4.584	L	L	N					

Sidesway - about XX axis: N about YY axis: N

Critical conditions for design load cases:

Case	Cap/Load	Condition
1000	9.517	Member out-plane C+Mx
1030	3.835	Member out-plane C+Mx
2030	3.320	Member out-plane C+Mx
2040	5.891	Member out-plane C+Mx
2050	2.733	Member out-plane C+Mx
<u>2210</u>	<u>1.721</u>	Section N+Mx
2230	2.268	Section N+Mx
2250	1.760	Section N+Mx
3210	3.364	Section N+Mx
3230	4.624	Section N+Mx
3250	3.451	Section N+Mx

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SECTION CHECKS

Case: 2210 Off: 0 Cap/Load= 1.721 Section N+Mx (8.3.2)

Design loads: N*= 9.05 t M*x= 11.04 M*y= 0.00
 Design capacities øNt= 466.20 øMsx= 18.99 øMsy= 12.57
 øNs= 0.00 øMrx= 18.99 øMry= 12.33

MEMBER/SEGMENT CHECKS

Case: 2210 Off: 0/1200 Cap/Load= 1.721 Section N+Mx (8.3.2)

Design loads: N*= 9.07 t M*x= 11.04 M*y= 0.00

Lmx= 4584 column o/a length βmx= 1.000
 Lmy= 4584 βmy= 0.000
 Lx= 4584 βme= -0.084
 Ly= 4584 αm= 1.793 BM modification factor
 Le= 1200 beam eff. length αs= 1.02 BM slend. reductn. factor
 Lz= 4584 torsion eff. length Transversely loaded.

Design capacities

øNt= 466.20 øMsx= 18.99 øMbx= 18.99 øMox= 18.99

øMrx= 18.99 øMix= 0.00 øMbxo= 0.00
 øMsy= 12.57 øMiy= 0.00 øNoz= 0.00
 øMry= 12.33 øMcx= 0.00

SHEAR CHECKS (Appendix I excluded)
 Case: 2250 Off: 0 Cap/Load= 16.986 Section N+Mx (8.3.2)

Design loads: V*= 10.41

Design capacities

øVv= 176.90 øMf= 11.43

MEMBER: 7 (Code Check to AS4100)

Rafter

Section: 125X75X4.0RHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D= 125.0 B= 75.0 T= 4.0
 Ag= 1480.0 rx= 45.4 Zx= 4.89E+04 Sx= 6.03E+04
 ry= 30.6 Zy= 3.70E+04 Sy= 4.24E+04
 J= 3.16E+06 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 1.000 Class Mx: Compact Zex= 6.030E+04
 Ae= 1480 Class My: Non-compact Zey= 3.991E+04

Member Restraints

No	Offset	/--Beam--/			Load	/-----Column-----/			
		Top	Btm	Cant		Ht	XX	ky	YY
1	0.000	L	L	N	S	Y	1.00	Y	1.00
2	1.200	L	N		S				
3	2.400	L	N		S				
4	3.600	L	N		S				
5	4.584	L	L	N					

Sideways - about XX axis: N about YY axis: N

Critical conditions for design load cases:

Case	Cap/Load	Condition
1000	7.930	Member out-plane C+Mx
1030	3.367	Member out-plane C+Mx
2030	2.801	Member out-plane C+Mx
2040	5.202	Member out-plane C+Mx
2050	2.364	Member out-plane C+Mx
2210	1.444	Section N+Mx
2230	1.875	Section N+Mx
<u>2250</u>	<u>1.432</u>	Section N+Mx
3210	2.834	Section N+Mx
3230	3.833	Section N+Mx
3250	2.806	Section N+Mx

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SECTION CHECKS

Case: 2250 Off: 0 Cap/Load= 1.432 Section N+Mx (8.3.2)

Design loads: N*= 9.38 t M*x= 13.27 M*y= 0.00
 Design capacities øNt= 466.20 øMsx= 18.99 øMsy= 12.57
 øNs= 0.00 øMrx= 18.99 øMry= 12.32

MEMBER/SEGMENT CHECKS

Case: 2250 Off: 0/1200 Cap/Load= 1.432 Section N+Mx (8.3.2)

Design loads: N*= 9.40 t M*x= 13.27 M*y= 0.00

Lmx= 4584 column o/a length βmx= 1.000
 Lmy= 4584 βmy= 0.000
 Lx= 4584 βme= -0.197
 Ly= 4584 αm= 1.640 BM modification factor
 Le= 1200 beam eff. length αs= 1.02 BM slend. reductn. factor
 Lz= 4584 torsion eff. length Transversely loaded.

Design capacities

$\phi N_t = 466.20$	$\phi M_{sx} = 18.99$	$\phi M_{bx} = 18.99$	$\phi M_{ox} = 18.99$
	$\phi M_{rx} = 18.99$	$\phi M_{ix} = 0.00$	$\phi M_{bxo} = 0.00$
	$\phi M_{sy} = 12.57$	$\phi M_{iy} = 0.00$	$\phi N_{oz} = 0.00$
	$\phi M_{ry} = 12.32$		$\phi M_{cx} = 0.00$

SHEAR CHECKS (Appendix I excluded)

Case: 2210 Off: 0 Cap/Load= 16.139 Section N+Mx (8.3.2)

Design loads: $V^* = 10.96$

Design capacities

$\phi V_v = 176.90$ $\phi M_f = 11.43$

EXAMPLE

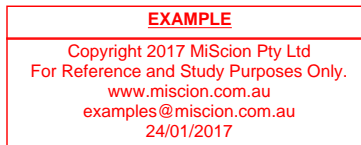
<p style="text-align: center;">EXAMPLE</p> <p style="text-align: center;">Copyright 2017 MiScion Pty Ltd For Reference and Study Purposes Only. www.miscion.com.au examples@miscion.com.au 24/01/2017</p>

Date: 20 May 2001

Project No: 881

Project:

References:



- AS 1111 1980 ISO Metric Hexagon Commercial Bolts and Screws
- AS 1112 1980 ISO Metric Hexagon Nuts including Thin Nuts, Slotted Nuts and Castle Nuts
- AS 1163 1991 Structural Steel Hollow Sections
- AS 1170.1 Loading Code: Dead and Live Loads
- AS 1170.1 Wind Loads
- AS 1250 SAA Steel Structures Code
- AS 1252 1983 High Strength Steel Bolts/Nuts/Washers for Structural Engineering.
- AS 1302 1991 Steel Reinforcing Bars For Concrete
- AS 1304 1991 Welded Wire Reinforcing Fabric For Concrete
- AS 1379 Ready Mixed Concrete
- AS 1397 1984 Steel sheet and strip — Hot-dipped zinc-coated or aluminium/zinc coated
- AS 1538 SAA Cold-Formed Steel Structures Code
- AS 1554 SAA Structural Steel Welding Code
- AS 1562 1992 Design and installation of sheet roof and wall cladding.
- AS 1627 1988 Metal Finishing—Preparation And Pre-treatment Of Surfaces.
- AS 1650 1989 Galvanised Coatings
- AS 2105 1992 Inorganic Zinc Silicate Paint
- AS 2312 Guide To The Protection Of Iron And Steel Against Exterior Atmospheric Corrosion
- AS 2870 Residential Slabs And Footings.
- AS 3566 Screws—Self-drilling—for the Building and Construction Industries.
- AS 3600 Concrete Structures.
- AS 4100 1990 Steel Structures.
- AS 4600 1996 Cold-Formed Steel Structures Code
- AWS D1.3-81 Structural Welding Code - Sheet Steel.
- BUILDING CODE OF AUSTRALIA
- Design of Portal Frame Buildings – S.T.Woolcock & S.Kitipornchai – AISC
- Design of Cold-Formed Steel Structures – Gregory P Hancock – AISC

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SAMPLE

APPENDIX – A

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INPUT/ANALYSIS REPORT

Job: c881d
 Title: C881: Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3
 SCH
 Type: Plane frame
 Date: 20 May 2001
 Time: 5:15 PM

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Nodes 7
 Members 6
 Spring supports 0
 Sections 3
 Materials 1
 Primary load cases 7
 Combination load cases 11

Analysis: Linear elastic

LOAD CASES

Case	Type	Analysis	Title
10	P	L	SWT
20	P	L	DEADLOADS {DL}
30	P	L	LIVE LOAD {LL}
40	P	L	OCCASIONAL POINT LOAD {PL}
1210	P	L	WINDLOAD WL[1,1]=WL0
1230	P	L	WINDLOAD WL[3,1]=WL90
1250	P	L	WINDLOAD WL[5,1]=WL180
1000	C	L	G = SWT+DL
1030	C	L	Q = LL + PL
2030	C	L	G+LL
2040	C	L	G+PL
2050	C	L	G+Q
2210	C	L	G+WL[1,1]
2230	C	L	G+WL[3,1]
2250	C	L	G+WL[5,1]
3210	C	L	G+WL[1,1]
3230	C	L	G+WL[3,1]
3250	C	L	G+WL[5,1]

Analysis Types:

S - Skipped (not analysed)
 L - Linear
 N - Non-linear

NODE COORDINATES

Node	X	Y	Z	Restraint
	m	m	m	
1	9.000	0.000	0.000	111111
2	-0.675	0.015	0.000	111110
3	-0.675	2.400	0.000	000000
4	0.000	2.400	0.000	000000
6	0.000	2.700	0.000	001110
7	9.000	2.700	0.000	001110
8	4.500	3.575	0.000	001110

MEMBER DEFINITION

Member	A	B	C	Prop	Matl	Rel-A	Rel-B	Length
								m
1	2	3	X	1	1	000000	000000	2.385
2	1	7	X	1	1	000000	000000	2.700
3	3	4	Y	1	1	000000	000000	0.675
5	4	6	-X	1	1	000000	000000	0.300
6	6	8	Y	2	1	000000	000000	4.584

7 7 8 Y 2 1 000000 000000 4.584

LIBRARY SECTIONS

Section	Library	Name	Axis	Comment
1	Asw	125X75X4.0RHS	Y	
2	Asw	125X75X4.0RHS	Y	
3	Asw	75X75X3.0SHS	Y	default

SECTION PROPERTIES

Section	Ax	Ay	Az	J	Iy	Iz	fact
	m2	m2	m2	m4	m4	m4	
1	1.480E-03	0.000E+00	0.000E+00	3.160E-06	1.390E-06	3.050E-06	
2	1.480E-03	0.000E+00	0.000E+00	3.160E-06	1.390E-06	3.050E-06	
3	8.410E-04	0.000E+00	0.000E+00	1.150E-06	7.160E-07	7.160E-07	

MATERIAL PROPERTIES

Material	E	u	Density	Alpha
	kN/m2		t/m3	/deg C
1	2.000E+08	0.3000	7.850E+00	1.170E-05

TABLE OF QUANTITIES

MATERIAL 1

Section	Name	Length	Mass	Comment
		m	tonne	
1	125X75X4.0RHS	6.060	0.070	
2	125X75X4.0RHS	9.168	0.107	
		-----	-----	
		15.229	0.177	

APPLIED LOADING

CASE 10: SWT

Gravitational Acceleration

X Comp	Y Comp	Z Comp
m/sec2	m/sec2	m/sec2
0.000	-9.810	0.000

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -1.736 FZ: 0.000

CASE 20: DEADLOADS {DL}

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
6	UNIF	FY	LO		-0.310			
7	UNIF	FY	LO		-0.310			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -2.790 FZ: 0.000

CASE 30: LIVE LOAD {LL}

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
6	UNIF	FY	GL		-0.760			
7	UNIF	FY	GL		-0.760			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -6.968 FZ: 0.000

CASE 40: OCCASIONAL POINT LOAD {PL}

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Node Loads

Node	X Force kN	Y Force kN	Z Force kN	X Moment kNm	Y Moment kNm	Z Moment kNm
8	0.000	-1.400	0.000	0.000	0.000	0.000

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -1.400 FZ: 0.000

CASE 1210: WINDLOAD WL[1,1]=WL0

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
6	UNIF	FY	LO		2.970			
7	UNIF	FY	LO		3.210			

Sum of Applied Loads (Global Axes):

FX: 0.210 FY: 27.810 FZ: 0.000

CASE 1230: WINDLOAD WL[3,1]=WL90

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
6	UNIF	FY	LO		2.470			
7	UNIF	FY	LO		2.470			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 22.230 FZ: 0.000

CASE 1250: WINDLOAD WL[5,1]=WL180

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
6	UNIF	FY	LO		3.210			
7	UNIF	FY	LO		2.970			

Sum of Applied Loads (Global Axes):

FX: -0.210 FY: 27.810 FZ: 0.000

CASE 1000: G = SWT+DL

Load Combinations

Case	Factor	
10	1.000	SWT
20	1.000	DEADLOADS {DL}

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -4.526 FZ: 0.000

CASE 1030: Q = LL + PL

Load Combinations

Case	Factor	
30	1.000	LIVE LOAD {LL}
40	1.000	OCCASIONAL POINT LOAD {PL}

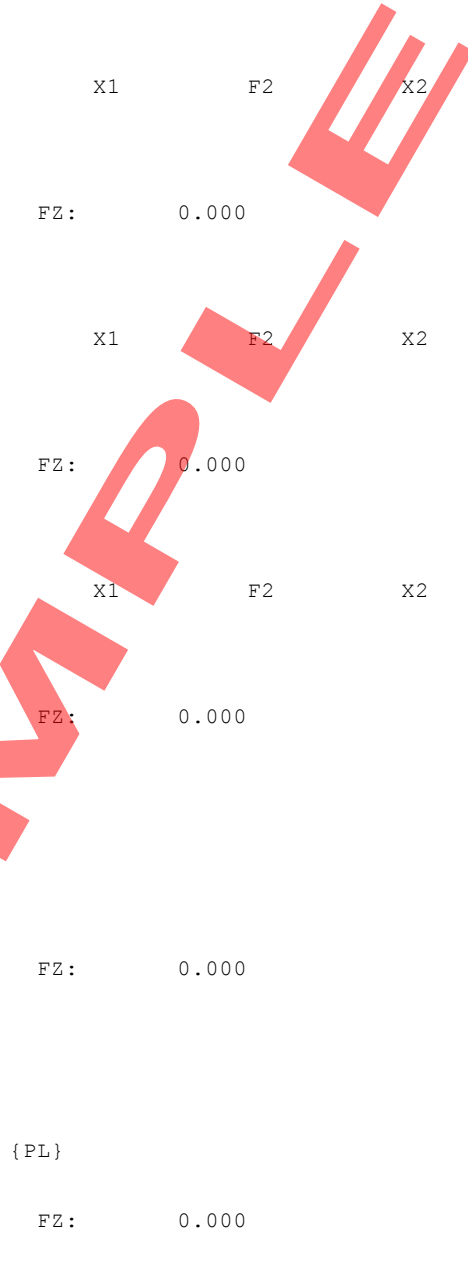
Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -8.368 FZ: 0.000

CASE 2030: G+LL

Load Combinations

Case	Factor	
30	1.000	LIVE LOAD {LL}
1000	1.000	G = SWT+DL



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Sum of Applied Loads (Global Axes):
FX: 0.000 FY: -11.494 FZ: 0.000

CASE 2040: G+PL

Load Combinations

Case Factor
40 1.000 OCCASIONAL POINT LOAD {PL}
1000 1.000 G = SWT+DL

Sum of Applied Loads (Global Axes):
FX: 0.000 FY: -5.926 FZ: 0.000

CASE 2050: G+Q

Load Combinations

Case Factor
1000 1.000 G = SWT+DL
1030 1.000 Q = LL + PL

Sum of Applied Loads (Global Axes):
FX: 0.000 FY: -12.894 FZ: 0.000

CASE 2210: G+WL[1,1]

Load Combinations

Case Factor
1000 1.000 G = SWT+DL
1210 1.000 WINDLOAD WL[1,1]=WL0

Sum of Applied Loads (Global Axes):
FX: 0.210 FY: 23.284 FZ: 0.000

CASE 2230: G+WL[3,1]

Load Combinations

Case Factor
1000 1.000 G = SWT+DL
1230 1.000 WINDLOAD WL[3,1]=WL90

Sum of Applied Loads (Global Axes):
FX: 0.000 FY: 17.704 FZ: 0.000

CASE 2250: G+WL[5,1]

Load Combinations

Case Factor
1000 1.000 G = SWT+DL
1250 1.000 WINDLOAD WL[5,1]=WL180

Sum of Applied Loads (Global Axes):
FX: -0.210 FY: 23.284 FZ: 0.000

CASE 3210: G+WL[1,1]

Load Combinations

Case Factor
1000 1.000 G = SWT+DL
1210 0.578 WINDLOAD WL[1,1]=WL0

Sum of Applied Loads (Global Axes):
FX: 0.121 FY: 11.549 FZ: 0.000

CASE 3230: G+WL[3,1]

Load Combinations

Case Factor
1000 1.000 G = SWT+DL
1230 0.578 WINDLOAD WL[3,1]=WL90

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Sum of Applied Loads (Global Axes):
FX: 0.000 FY: 8.323 FZ: 0.000

CASE 3250: G+WL[5,1]

Load Combinations

Case	Factor	
1000	1.000	G = SWT+DL
1250	0.578	WINDLOAD WL[5,1]=WL180

Sum of Applied Loads (Global Axes):
FX: -0.121 FY: 11.549 FZ: 0.000

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APPENDIX - B

EXAMPLE

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INPUT/ANALYSIS REPORT

Job: c881d
 Title: C881: Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3
 SCH
 Type: Plane frame
 Date: 20 May 2001
 Time: 5:26 PM

Nodes 7
 Members 6
 Spring supports 0
 Sections 3
 Materials 1
 Primary load cases 7
 Combination load cases 11

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Analysis: Linear elastic

LOAD CASES

Case	Type	Analysis	Title
1000	C	L	G = SWT+DL
1030	C	L	Q = LL + PL
2030	C	L	G+LL
2040	C	L	G+PL
2050	C	L	G+Q
2210	C	L	G+WL[1,1]
2230	C	L	G+WL[3,1]
2250	C	L	G+WL[5,1]
3210	C	L	G+WL[1,1]
3230	C	L	G+WL[3,1]
3250	C	L	G+WL[5,1]

Analysis Types:

S - Skipped (not analysed)
 L - Linear
 N - Non-linear

NODE TABLE NOT PRINTED

MEMBER TABLE NOT PRINTED

SECTION PROPERTY TABLE NOT PRINTED

MATERIAL TABLE NOT PRINTED

CONDITION NUMBER

Maximum condition number: 2.259E+02 at node: 6 DOFN: 2

SIGN CONVENTION

Positive Forces (Member Axes):

Axial - Tension Shear - End A sagging
 Torque - Right-hand twist Moment - Sagging

Deflections:

Global deflections are absolute.
 Local deflections are relative to chord joining displaced end nodes.

MEMBER FORCES AND DEFLECTIONS

Section: 1 125X75X4.0RHS Y

MEMBER 1: Nodes 2 - 3 Section 1: 125X75X4.0RHS Y

Member: 1 Summary of Minimum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2050	0.00	Fx	-6.365	-3.793	0.000	0.000	0.000	0.000
2050	0.00	Fy	-6.365	-3.793	0.000	0.000	0.000	0.000
1000	0.00	Fz	-2.256	-1.136	0.000	0.000	0.000	0.000

1000	0.00	Mx	-2.256	-1.136	0.000	0.000	0.000	0.000
1000	0.00	My	-2.256	-1.136	0.000	0.000	0.000	0.000
2250	2.39	Mz	11.861	7.010	0.000	0.000	0.000	-16.720

Member: 1 Summary of Maximum member forces

Column

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2250	2.39	Fx	11.861	7.010	0.000	0.000	0.000	-16.720
2250	0.00	Fy	11.589	7.010	0.000	0.000	0.000	0.000
1000	0.00	Fz	-2.256	-1.136	0.000	0.000	0.000	0.000
1000	0.00	Mx	-2.256	-1.136	0.000	0.000	0.000	0.000
1000	0.00	My	-2.256	-1.136	0.000	0.000	0.000	0.000
2050	2.39	Mz	-6.093	-3.793	0.000	0.000	0.000	9.046

MEMBER 2: Nodes 1 - 7 Section 1: 125X75X4.0RHS Y

Member: 2 Summary of Minimum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2050	0.00	Fx	-6.529	3.793	0.000	0.000	0.000	3.064
2250	0.00	Fy	11.695	-7.220	0.000	0.000	0.000	-6.226
1000	0.00	Fz	-2.269	1.136	0.000	0.000	0.000	0.934
1000	0.00	Mx	-2.269	1.136	0.000	0.000	0.000	0.934
1000	0.00	My	-2.269	1.136	0.000	0.000	0.000	0.934
2050	2.70	Mz	-6.221	3.793	0.000	0.000	0.000	-7.176

Member: 2 Summary of Maximum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2210	2.70	Fx	12.483	-6.771	0.000	0.000	0.000	13.155
2050	0.00	Fy	-6.529	3.793	0.000	0.000	0.000	3.064
1000	0.00	Fz	-2.269	1.136	0.000	0.000	0.000	0.934
1000	0.00	Mx	-2.269	1.136	0.000	0.000	0.000	0.934
1000	0.00	My	-2.269	1.136	0.000	0.000	0.000	0.934
2250	2.70	Mz	12.003	-7.220	0.000	0.000	0.000	13.268

MEMBER 3: Nodes 3 - 4 Section 1: 125X75X4.0RHS Y

Member: 3 Summary of Minimum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2050	0.00	Fx	-3.793	-6.093	0.000	0.000	0.000	-9.046
2050	0.00	Fy	-3.793	-6.093	0.000	0.000	0.000	-9.046
1000	0.00	Fz	-1.136	-1.985	0.000	0.000	0.000	-2.711
1000	0.00	Mx	-1.136	-1.985	0.000	0.000	0.000	-2.711
1000	0.00	My	-1.136	-1.985	0.000	0.000	0.000	-2.711
2050	0.00	Mz	-3.793	-6.093	0.000	0.000	0.000	-9.046

Member: 3 Summary of Maximum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2250	0.00	Fx	7.010	11.861	0.000	0.000	0.000	16.720
2250	0.68	Fy	7.010	11.938	0.000	0.000	0.000	8.688
1000	0.00	Fz	-1.136	-1.985	0.000	0.000	0.000	-2.711
1000	0.00	Mx	-1.136	-1.985	0.000	0.000	0.000	-2.711
1000	0.00	My	-1.136	-1.985	0.000	0.000	0.000	-2.711
2250	0.00	Mz	7.010	11.861	0.000	0.000	0.000	16.720

MEMBER 5: Nodes 4 - 6 Section 1: 125X75X4.0RHS Y

Member: 5 Summary of Minimum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2050	0.00	Fx	-6.016	3.793	0.000	0.000	0.000	-4.960
2250	0.00	Fy	11.938	-7.010	0.000	0.000	0.000	8.688
1000	0.00	Fz	-1.908	1.136	0.000	0.000	0.000	-1.397
1000	0.00	Mx	-1.908	1.136	0.000	0.000	0.000	-1.397
1000	0.00	My	-1.908	1.136	0.000	0.000	0.000	-1.397
2050	0.30	Mz	-5.982	3.793	0.000	0.000	0.000	-6.097

Member: 5 Summary of Maximum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2250	0.30	Fx	11.972	-7.010	0.000	0.000	0.000	10.791
2050	0.00	Fy	-6.016	3.793	0.000	0.000	0.000	-4.960

1000	0.00	Fz	-1.908	1.136	0.000	0.000	0.000	-1.397
1000	0.00	Mx	-1.908	1.136	0.000	0.000	0.000	-1.397
1000	0.00	My	-1.908	1.136	0.000	0.000	0.000	-1.397
2210	0.30	Mz	11.492	-6.981	0.000	0.000	0.000	11.036

Section: 2 125X75X4.0RHS Y

MEMBER 6: Nodes 6 - 8 Section 2: 125X75X4.0RHS Y

Member: 6 Summary of Minimum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2050	0.00	Fx	-4.864	-5.148	0.000	0.000	0.000	-6.097
2050	0.00	Fy	-4.864	-5.148	0.000	0.000	0.000	-6.097
1000	0.00	Fz	-1.473	-1.622	0.000	0.000	0.000	-1.738
1000	0.00	Mx	-1.473	-1.622	0.000	0.000	0.000	-1.738
1000	0.00	My	-1.473	-1.622	0.000	0.000	0.000	-1.738
2250	3.67	Mz	9.245	0.189	0.000	0.000	0.000	-8.653

Member: 6 Summary of Maximum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2250	4.58	Fx	9.265	-2.367	0.000	0.000	0.000	-7.655
2250	0.00	Fy	9.166	10.415	0.000	0.000	0.000	10.791
1000	0.00	Fz	-1.473	-1.622	0.000	0.000	0.000	-1.738
1000	0.00	Mx	-1.473	-1.622	0.000	0.000	0.000	-1.738
1000	0.00	My	-1.473	-1.622	0.000	0.000	0.000	-1.738
2210	0.00	Mz	9.046	9.949	0.000	0.000	0.000	11.036

MEMBER 7: Nodes 7 - 8 Section 2: 125X75X4.0RHS Y Rafter

Member: 7 Summary of Minimum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2050	0.00	Fx	-4.910	-5.383	0.000	0.000	0.000	-7.176
2050	0.00	Fy	-4.910	-5.383	0.000	0.000	0.000	-7.176
1000	0.00	Fz	-1.490	-1.709	0.000	0.000	0.000	-2.134
1000	0.00	Mx	-1.490	-1.709	0.000	0.000	0.000	-2.134
1000	0.00	My	-1.490	-1.709	0.000	0.000	0.000	-2.134
2210	3.67	Mz	9.108	0.736	0.000	0.000	0.000	-8.295

Member: 7 Summary of Maximum member forces

Case	Offset	Act	Fx	Fy	Fz	Mx	My	Mz
2250	4.58	Fx	9.477	-1.276	0.000	0.000	0.000	-7.655
2210	0.00	Fy	9.028	10.961	0.000	0.000	0.000	13.155
1000	0.00	Fz	-1.490	-1.709	0.000	0.000	0.000	-2.134
1000	0.00	Mx	-1.490	-1.709	0.000	0.000	0.000	-2.134
1000	0.00	My	-1.490	-1.709	0.000	0.000	0.000	-2.134
<u>2250</u>	0.00	Mz	<u>9.378</u>	10.405	0.000	0.000	0.000	<u>13.268</u>

SUPPORT REACTIONS

Node	Case	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
1	1000	-1.136	2.269	0.000	0.000	0.000	0.934
	1030	-2.656	4.260	0.000	0.000	0.000	2.130
	2030	-3.206	5.826	0.000	0.000	0.000	2.612
	2040	-1.723	2.972	0.000	0.000	0.000	1.386
	2050	-3.793	6.529	0.000	0.000	0.000	3.064
	2210	6.771	-12.175	0.000	0.000	0.000	-5.127
	2230	5.364	-9.085	0.000	0.000	0.000	-4.350
	2250	<u>7.220</u>	-11.695	0.000	0.000	0.000	<u>-6.226</u>
	3210	<u>3.434</u>	-6.080	0.000	0.000	0.000	<u>-2.569</u>
	3230	2.621	-4.294	0.000	0.000	0.000	-2.120
3250	3.694	-5.802	0.000	0.000	0.000	-3.204	
2	1000	1.136	2.256	0.000	0.000	0.000	0.000
	1030	2.656	4.108	0.000	0.000	0.000	0.000
	2030	3.206	5.668	0.000	0.000	0.000	0.000
	2040	1.723	2.953	0.000	0.000	0.000	0.000
	2050	<u>3.793</u>	<u>6.365</u>	0.000	0.000	0.000	0.000

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2210	-6.981	-11.109	0.000	0.000	0.000	0.000
2230	-5.364	-8.619	0.000	0.000	0.000	0.000
2250	<u>-7.010</u>	<u>-11.589</u>	0.000	0.000	0.000	0.000
3210	-3.555	-5.469	0.000	0.000	0.000	0.000
3230	-2.621	-4.030	0.000	0.000	0.000	0.000
3250	-3.572	-5.746	0.000	0.000	0.000	0.000

(Reactions act on structure in positive global axis directions.)

SUM OF REACTIONS

Case	Force-X kN	Force-Y kN	Force-Z kN
1000	0.000	4.526	0.000
1030	0.000	8.368	0.000
2030	0.000	11.494	0.000
2040	0.000	5.926	0.000
2050	0.000	12.894	0.000
2210	-0.210	-23.284	0.000
2230	0.000	-17.704	0.000
2250	0.210	-23.284	0.000
3210	-0.121	-11.549	0.000
3230	0.000	-8.323	0.000
3250	0.121	-11.549	0.000

RESIDUALS

Case	DOFN	Residual
10	8	1.381E-13
20	2	-3.977E-13
30	8	9.921E-13
40	8	3.084E-13
1210	5	-7.844E-12
1230	9	-1.469E-12
1250	8	-2.668E-12

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APPENDIX - C

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Queries relating to these computations should be directed to Roy Harrison

Roy Harrison & Associates

Job: c881d

C881: Pitched Canopy: 9m Wide x 2.7m Eaves, Bays @3m, TC3

SCH

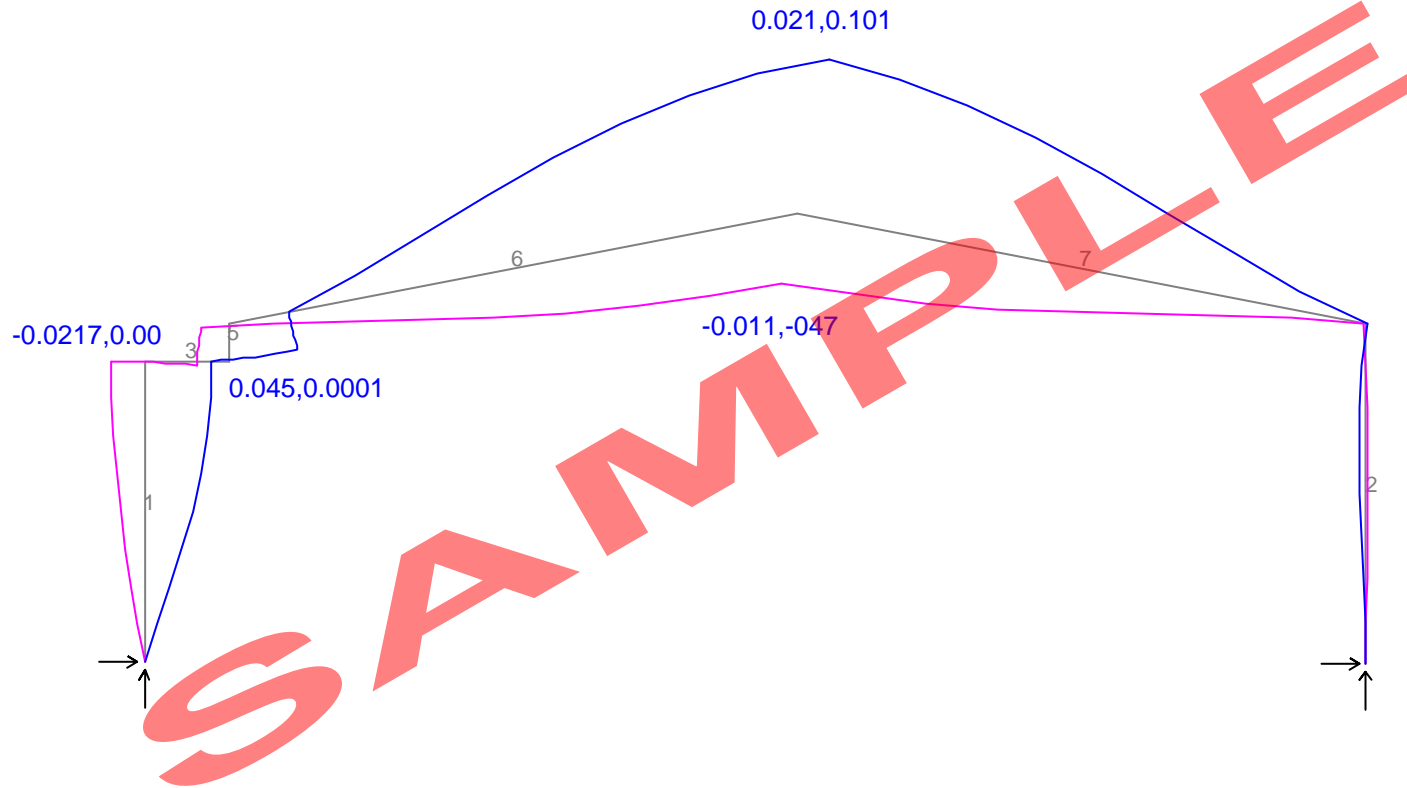
20 May 2001

09:34 PM

Load Cases:

— 2030 C G+LL

— 2250 C G+WL[5,1]



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Y
↑
Z → X
theta: 270 phi: 0

Deflections

Displaced Shape