
STRUCTURAL CALCULATIONS

FOR

CURVED ROOF CARPORT

3m Wide x 2m High

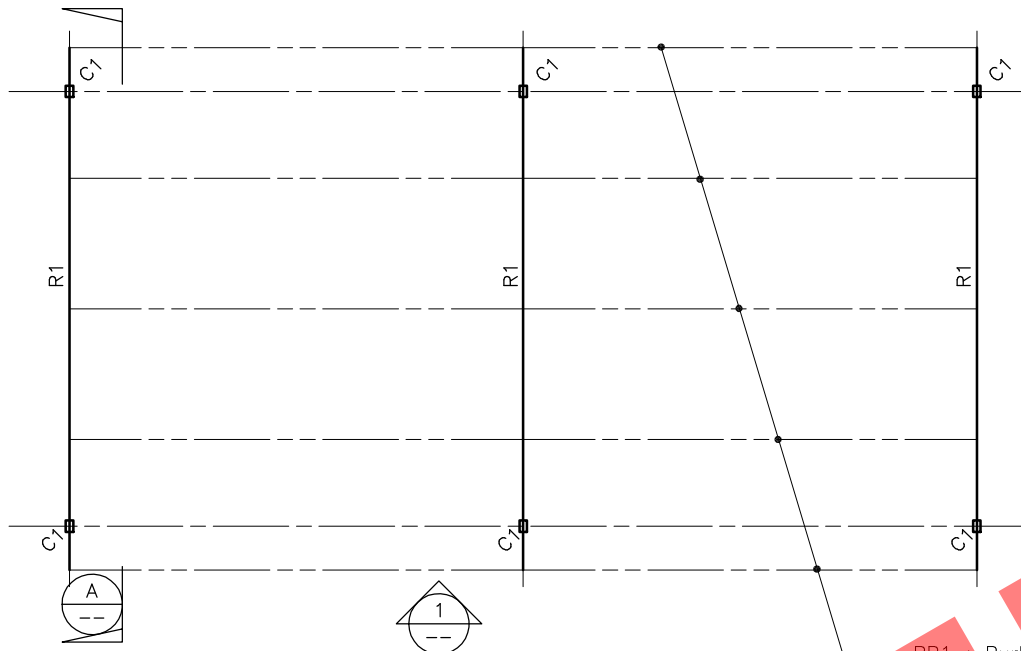
Report No: 1004

October, 2001

**ROY HARRISON
& ASSOCIATES
CONSULTING ENGINEERS**

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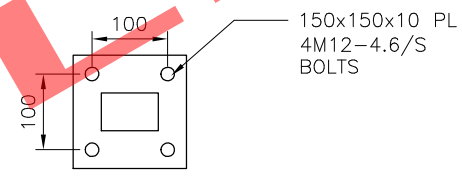


FRAMING PLAN
1:50

SCHEDULE OF STEELWORK		
MEMBER	MARK	SIZE
COLUMNS	C1	75x50x2.0 RHS
RAFTERS	R1	75x50x2.0 RHS
PURLINS	RP1	50x25x2.0 RHS

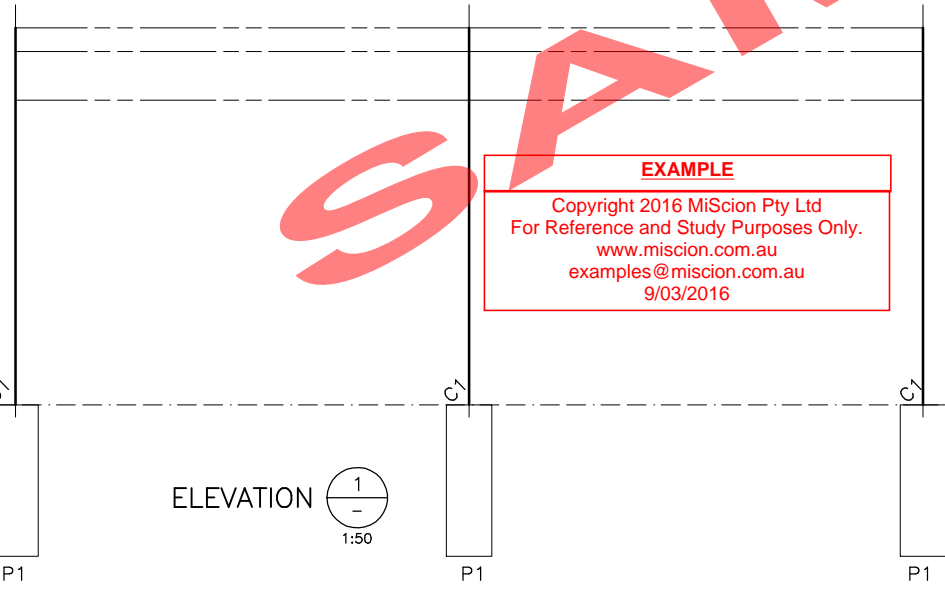
NB: ALL RHS ARE DURAGAL GRADE 450 LO.

CONCRETE FOOTING SCHEDULE	
COLUMN C1	
P1	∅ 300 x 1000 DEEP

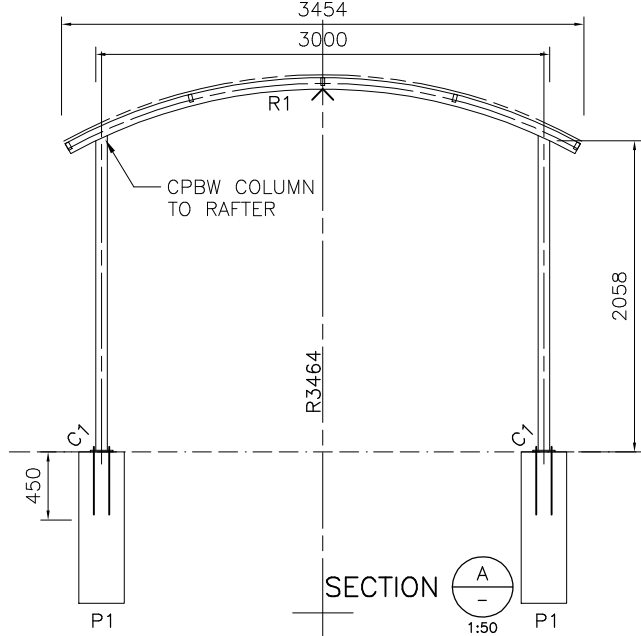


PLAN COLUMN BASE
1:10

- NOTES
- Unless noted otherwise:
 - All dimensions in mm.
 - All bolts grade 8.8/S.
 - All welds 4mm E48XX continuous fillet weld.
 - All fitments 5mm Pit.
 - PLates grade 250MPa.
 - All bolts M16.
 - All workmanship and materials shall comply with AS4100 & AS4600.
 - All welding to comply with AS1554 Parts 1, 2, and 3.
 - Concrete to Piers 20MPa.
 - All steelwork to be adequately propped and braced during construction until all permanent bracing and cladding has been erected.
 - Self-drilling screws to comply with AS3566.



ELEVATION
1:50



SECTION
1:50

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BUILDING APPROVAL

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*T/A Roy Harrison & Associates

CURVED ROOF CANOPY
 3m WIDE x 2m HIGH

Terrain Category 2

STEELWORK LAYOUT

DRAWN	SCH
DESIGNED	SCH
CHECKED	ISSUED 03/10/01
SCALE	As shown DO NOT SCALE
SIZE	DRAWING NUMBER REVISION
A4	1004/01

CAD FILE : C1004S01.DWG Wed 03 Oct 01 - 17:06

Date: 03 October 2001

Project No: 1004

Project: CURVED ROOF CANOPY - STANDARD - TC2,

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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Queries relating to these computations should be directed to Roy Harrison

CONTENTS

CURVED ROOF CARPORT : 3m Wide x 2m High

Project No: 1004

	Page
1. Summary :	1
2. Loads :	2
3. Wind Pressure Coefficients	3 - 6
4. Purlins :	7 - 8
5. Footing Piers	9
6. Portal Geometry :	10
7. Portal Loads :	11 - 15
8. Portal Force Envelopes:	16 – 18
9. Portal Frame Member Design	19 - 21

Appendices :

- A Microstran Analysis Input Data
- B Microstran Analysis Force Output

..ooOoo..

SAMPLE

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REF.: 1004	PAGE:
DESIGN: SCH	DATE: 03-Oct-2001

TITLE :

Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m, TC2

SUMMARY

Portal Frame Curved Roof Canopy

Location : Adelaide

Wind Region : A

Terrain Category : 2

PORTAL FRAME 3m Wide x 2m High

Rafter : 75 x 50 x 2.0 RHS

Column : 75 x 50 x 2.0 RHS

ROOF

Purlins : 50 x 25 x 2 RHS

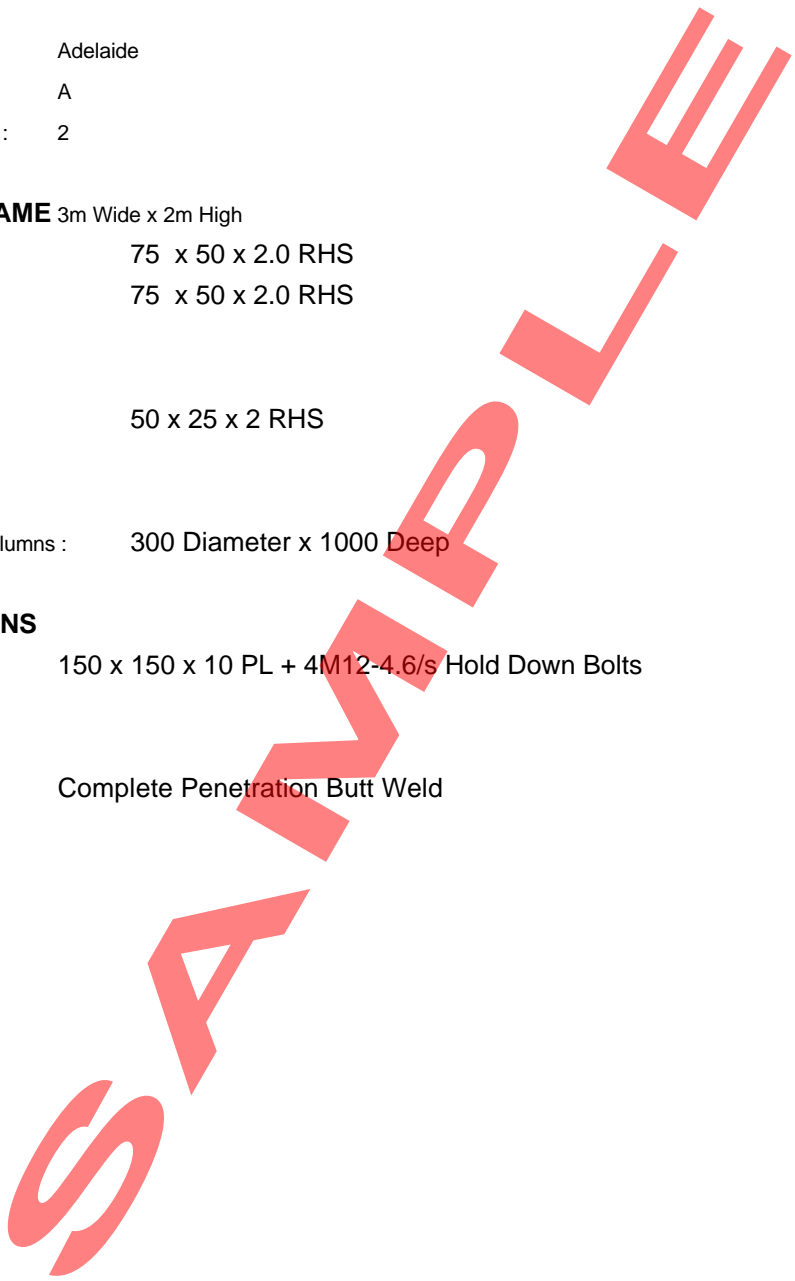
PIERS

Portal Columns : 300 Diameter x 1000 Deep

CONNECTIONS

Base : 150 x 150 x 10 PL + 4M12-4.6/s Hold Down Bolts

Eaves : Complete Penetration Butt Weld



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DESIGN:	SCH	DATE:	03-Oct-2001

TITLE :

Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m, TC2

FRAME LOADING

DEAD

Sheeting	0.04 kPa = kN/m ²				
Purlins/Girts	0.02 kPa = kN/m ²				
	$\frac{\sum DL}{0.07 \text{ kPa}}$	x	3	=	0.20 kN/m
Swt Frame					0.04 kN/m
				$\sum DL$	<u>0.23 kN/m</u>

LIVE (Roof)

Projected Area of Portal Rafter A	=	3.00 x 3.00	
	=	9 m ²	
LL	=	(1.8/A + 0.12)	= 0.3 kPa
$\sum LL$	=	0.3 kPa x	3 = <u>1 kN/m</u>

OCCASSIONAL POINT LOAD (OPL)

Industrial	$\sum OPI =$	<u>1.4 kN</u>	Domestic
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REF.:	1004	PAGE:	
DESIGN:	SCH	DATE:	03-Oct-2001

TITLE :

Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m, TC2

Doubly Pitched Canopy

{adopt: an equivalent doubly pitched roof for the curved canopy: the pitch equals the tangent angle for midpoint of each half of the roof.}

Alpha	14.4 degrees =	0.25 radians =	Pitch 1 in	3.90
Building Eaves Hght	2 m	Building Span		3 m
Bay Spacing	3 m	Number of Bays		2
Building Length	6 m	Number of Columns		6

Region	A	Vp =	41 m/s	Vs =	38 m/s
Location	: Adelaide	Vu =	50 m/s	sensitivity	{static analysis acceptable}
b/d =	2.00	d/b =	0.50	h/d =	0.67

Q = 0
 Wind Classification to AS1170
a < 60 h = he = 2.000 m

Tcat = 2 TC2.0
 M[z,cat] = 0.85
 M[s] = 1 NS
 M[t] = 1 T1
 M[i] = 1
 directional M[d] = 0.95

Q = 90
 Wind Classification to AS1170
 h = ht = 2.385 m

Tcat = 2 TC2.0
 M[z,cat] = 0.85
 M[s] = 1 NS
 M[t] = 1 T1
 M[i] = 1
 M[d] = 0.95

Vz =	Perm	Limit	
	33.1	40.4 m/s	
qz =	0.66	0.98 kPa	

Vz =	Perm	Limit	
	33.1	40.4 m/s	
qz =	0.66	0.98 kPa	

Wind Classification to AS4055
N3 WP41, WU50
 Vz = 41 50 m/s
 qz = 1.01 1.50 kPa

Wind Classification to AS4055
N3 WP41, WU50
 Vz = 41 50 m/s
 qz = 1.01 1.50 kPa

Design	<u>AS1170</u>	<u>Limit State</u>
Vz =	40.4 m/s	
qz =	0.98 kPa	
wz =	2.93 kN/m	

Design	<u>AS1170</u>	<u>Limit State</u>
Vz =	40.4 m/s	
qz =	0.98 kPa	
wz =	2.93 kN/m	

b =	3.00 m	d =	6.00 m
local pressure extent = 'a' = min	$\begin{matrix} 0.2 b \\ 0.2 d \\ ht \end{matrix}$	= min	$\begin{matrix} 0.600 \\ 1.200 \\ 2.385 \end{matrix}$ = 0.6 m
a/2 =	0.3 m		
Length along Slope of Rafter =		1.549 m	

Area Reduction Factors

Tributary Area

		m ²	Ka
Rafter			
Aligned	1.549 x 3.000	= 4.65	1.00
Projected	1.500 x 3.000	= 4.50	1.00
Column			
Aligned	2.000 x 3.000	= 6.00	1.00

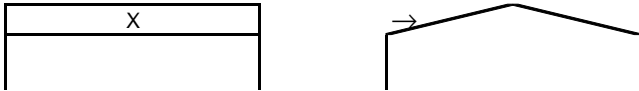
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TITLE :

Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m, TC2

Doubly Pitched Canopy

Q = 0 Transverse



a < 60 h = he = 2.000 m
 length b = 6.000 m
 span d = 3.000 m
 h/d = 0.67
 d/h = 1.50
 d/b = 0.50

State : Blocked Under

a = 144	Cpw	Cpl
-ve	-1.2	-1.3
+ve		

Frictional Drag on Roof

F1 = 0.01 bd qz
 √ F1 = smooth/parallel to ribs 0.18 kN
 2F1 = across corrugations 0.35 kN
 4F1 = across ribs 0.70 kN

Drag on Frame

Assume :

125.00 SHS column	Cd	1.30
-------------------	-----------	------

ki	ksh
1.00	1.00

Fd = ki ksh kar Cd Az qz

l/b	Kar	Az	Fd
		m ²	kN
Column	16.0	0.90	0.25
Rafter			0.29
			Σ 0.29

Q = 90 Longitudinal



h = ht = 2.385 m
 span b = 3.000 m
 length d = 6.000 m
 h/d = 0.40
 d/h = 2.52
 d/b = 2.00

State : Blocked Under

a = 144	Cpw	Cpl
-ve	-1.0	-0.8
+ve	0.4	0.4

Frictional Drag on Roof

F1 = 0.01 bd qz
 √ F1 = smooth/parallel to ribs 0.18 kN
 2F1 = across corrugations 0.35 kN
 4F1 = across ribs 0.70 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	16.0	0.90	0.25
Rafter	12.4	1.00	0.19
			Σ 0.65

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Wind on Gable End {if present}

Cpw = 0.7
 Cpl = -0.5
 Cpn = 1.2

Full Rise of Roof = 0.385 m
 Area of Gable = 1.695 m²
 {for gable end to curved roof}

Uplift

= bd Cpn qz
 Total = 22.9 kN
 5.7 kN/column

Uplift

= bd Cpn qz
 Total = 17.6 kN
 4.4 kN/column

REF.:	1004	PAGE:	
DESIGN:	SCH	DATE:	03-Oct-2001

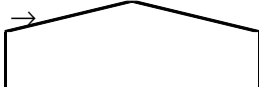
TITLE :

Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m, TC2

Doubly Pitched Canopy

Q = 0

Transverse



Loads on Single Frame supporting 1 bay

Drag Load Roof {1 bay}	0.09 kN @top col.
Drag on Windward Column	0.14 kN/m
Winward Roof	-3.52 kN/m
Leeward Roof	-3.81 kN/m
Drag on Leeward Column	0.14 kN/m

Q = 90

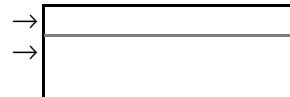
Longitudinal



Loads on Single Frame supporting 1 bay

Winward Roof	-2.93 kN/m
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Loads on Longitudinal Frame



Drag Load Roof {1 side}	0.35 kN
Drag on rafter	0.36 kN/rafter
Drag on Column	0.29 kN/column

SAMPLE

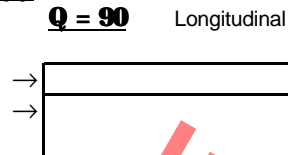
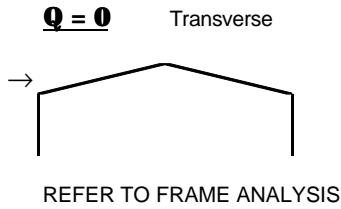
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TITLE :

Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m, TC2

Doubly Pitched Canopy



Total Moment Base of Column 1.20 kNm

Base Connection

lever arm	=	100 mm
Total Number of Bolts	=	4 total
Bolt Tension	=	12.0 kN/bolt plane
	=	6.0 kN/bolt
M12-4.6/s phi . Ntf	=	27 kN/bolt
phi . Vfn	=	15.1 kN/bolt
Plate Strength	=	250 MPa
Plate Thickness	=	10 mm
Plate length	=	150 mm
Plate Width	b =	150 mm
Bolt dist.	=	35 mm
phi	=	0.9

Applied Plate Moment = 0.21 kNm
 allowing for double curvature

Plate Modulus	=	2.500E+04 mm ³
Plate Capacity	=	5.63 kNm

applied	0.21	<	capacity	5.63 kNm	ok
---------	------	---	----------	----------	----

Column Check

Drag load on all Roof	0.70 kN
one bay	0.35 kN
one column	0.18 kN
Drag load on 1 Rafter	0.36 kN
Wind on Gable End	0.50 kN/column
Total Load at Roof Level	<u>1.03 kN</u>
Average Height = (he + ht)/2	2.19 m
Resultant Moment	<u>2.26 kNm</u>
Drag load on 1 Column	0.29 kN
Height of Application	1 m
Resultant Moment	<u>0.29 kNm</u>

Total Moment Base of Column 2.55 kNm

M* <= phi Msy phi = 0.9
 ∴
 Trial : **75 x 50 x 2.0 RHS** **DuraGal**

applied	2.55	<	capacity	2.86 kNm	ok
---------	------	---	----------	----------	----

Base Connection (check)

lever arm	=	100 mm
Total Number of Bolts	=	4 total
Bolt Tension	=	25.5 kN/bolt plane
	=	12.8 kN/bolt
M12-4.6/s phi . Ntf	=	27 kN/bolt
phi . Vfn	=	15.1 kN/bolt
Plate Strength	=	250 MPa
Plate Thickness	=	10 mm
Plate length	b =	150 mm
Plate Width	=	150 mm
Bolt dist.	=	35 mm
phi	=	0.9

Applied Plate Moment = 0.45 kNm
 allowing for double curvature

Plate Modulus	=	2.500E+04 mm ³
Plate Capacity	=	5.63 kNm

applied	0.45	<	capacity	5.63 kNm	ok
---------	------	---	----------	----------	----

ADOPT: Base Connection
 4M12-4.6/s Hold Down Bolts
 150 x 150 x 10 PL

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TITLE :

Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m, TC2

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
3	1.35	0.3	1.50	1.50
dist.	9.00	1.82	0.09	

a	b {'a'}	x1	L-x1
1.20	0.6	1.50	1.50
1.44	0.36		

	kN/m	kN
w1 full	-1.30	-3.90
w2 partial	-1.30	-0.39
Σ =	-2.60	-4.29

	kN/m	kN
	-1.30	-3.90
	-0.65	-0.39
Σ =	-1.95	-4.29

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 ↑↑↑	-0.28	-0.20	-0.20
Σ =	-1.74	-2.15	-2.15
Equiv UDL : Cp_n	-1.55		

Moment	End Reactions	
	M[max]	Ra
kNm	kN	kN
-1.46	-1.95	-1.95
-0.26	-0.20	-0.20
-1.73	-2.15	-2.15
-1.53		

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 ↑↑↑	-0.05	-0.37	-0.02
Σ =	-1.52	-2.32	-1.97
Equiv UDL : Cp_n =	-1.35		

Moment	End Reactions	
	M[max]	Ra
kNm	kN	kN
-1.46	-1.95	-1.95
-0.09	-0.35	-0.04
-1.56	-2.30	-1.99
-1.38		

MAX Equiv UDL : Cp_n = **-1.55**

-1.53

'a'/2 local area extent	kl= 2.0
WIND	-1.20
→	↑↑↑↑↑↑ -1.20+0.0
θ=90°	↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑

'a' local area extent	kl= 1.5
WIND	-1.2/2
→	↑↑↑↑↑↑ -1.20+0.0
θ=90°	↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑

	kN/m	kN
w1 full	-1.20	-3.6
w2 partial	-1.2	-0.36
Σ =	-2.40	-3.96

	kN/m	kN
	-1.20	-3.6
	-0.6	-0.36
Σ =	-1.80	-3.96

Partial Load Occuring At End of Span	Moment	End Reactions	
	M[max]	Ra	Rb
	kNm	kN	kN
full	-1.35	-1.80	-1.80
partial at end ↑↑↑	-0.05	-0.34	-0.02
Σ =	-1.40	-2.14	-1.82
Equiv UDL : Cp_n =	-1.24		

Moment	End Reactions	
	M[max]	Ra
kNm	kN	kN
-1.35	-1.80	-1.80
-0.09	-0.32	-0.04
-1.44	-2.12	-1.84
-1.28		

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TITLE :

Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m, TC2

span = 3000 Int = 900 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}

		dwe	Cpn	x	qz	=	Resultant	
{ dwe	≤	0.300 m = a/2 }	-1.24	x	0.98[kPa]	=	-1.22[kPa]	↑
{ dwe	≤	0.600 m = a }	-1.28	x	0.98[kPa]	=	-1.25[kPa]	↑
{ dwe	>	0.600 m = a }	-1.20	x	0.98[kPa]	=	-1.18[kPa]	↑

SIDE WIND

qz = 0.98[kPa] {theta = 0}

		dwe	Cpn	x	qz	=	Resultant	
{ dwe	≤	0.300 m = a/2 }	-1.55	x	0.98[kPa]	=	-1.52[kPa]	↑
{ dwe	≤	0.600 m = a }	-1.53	x	0.98[kPa]	=	-1.50[kPa]	↑
{ dwe	>	0.600 m = a }	-1.30	x	0.98[kPa]	=	-1.27[kPa]	↑

Forces	+ ↑	- ↓
--------	-----	-----

Internal

Edge

a

Edge

a/2

	Spacing	Area	Wind	Live Load	Sheeting	Purlin swt	Resultant	SS Moments
	m	m ²	kPa	kPa	kPa	kN/m	w*=kG+kQ kN/m	kNm
Inwards	0.900	2.70	2.70	-0.79	-0.04	-0.06	-1.18	-1.32
Outwards	0.900	2.70	1.27	-0.79	-0.04	-0.06	1.07	1.21
Inwards	0.900	2.70	2.70	-0.79	-0.04	-0.06	-1.18	-1.32
Outwards	0.900	2.70	1.50	-0.79	-0.04	-0.06	1.28	1.44
Inwards	0.900	2.70	2.70	-0.79	-0.04	-0.06	-1.18	-1.32
Outwards	0.900	2.70	1.52	-0.79	-0.04	-0.06	1.29	1.45

Trial DuraGal Grade 450 Lo 50 x 25 x 2.0 RHS

	Inwards	OutWards	
capacity @3m	1.63	1.63	kN/m
applied load factor	1.32	1.45	kN/m
	1.23	1.12	
Combined Assessment	ok	ok	

from OneSteel DCT

Spacing
 @ 900 c/c {for distance < 300 from edges}
 @ 900 c/c {for 300 < distance from edges < 600}
 @ 900 c/c {for distance > 600 from edges}

Adopt: **PURLINS**

DuraGal Grade 450 Lo 50 x 25 x 2.0 RHS

spaced at 900 mm centres

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Axial Reserve Eaves and Ridge kN simplified procedure BHP/Lysaght

TITLE :

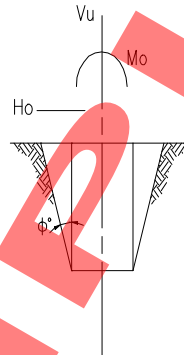
Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m, TC2

PIERS FOR COLUMNS (based on main portal frame)

ASSUME SANDY SOIL				Density	kg/m ³	kN/m ³
active	0.27	Total cone height {D+f}	1.11	Soil	1937.00	19.00
passive	3.69	Cone Vol {V_tot}	0.71	Concrete	2400.00	23.54
soil cone {e}	0.63	Apex vol {v2}	0.01	Limit State DL load factor = 0.80 Overturning Factor = 1.00 Diameter d = 0.3 Depth D = 0.9 Vu = 5.7 Vd = 0		
apex length {}	0.21	Cylinder vol {v_cyl}	0.06			
diameter {f}	1.56	$\gamma =$	1900 kN/m ³			
		$c =$	0.00 kPa			
		$\phi =$	35 0.61 radians			
allowable bearing	$p_{max} =$		150.00 kPa			

Check Up Lift

	Volume [m ³]	Force [kN]
Soil	0.64	12.19
Concrete	0.06	1.50
cohes		0.00
DL Vd		0.00
Σ		13.69 kN



$FoS = 0.80 \times 13.69 / 5.70 = 1.92 > 1.00 \text{ ok}$

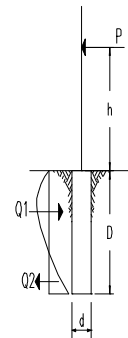
Check Over Turning

$h = Mo / Ho = 2.55 / 1.32 = 1.93 \text{ m}$

$Q2 = P(10h + 3.4D) / (5.6 D)$
 $= 1.32 \times (10 \times 1.93 + 3.4 \times 0.90) / (5.6 \times 0.90)$
 $= 5.86 \text{ kN}$

$Q1 = Q2 + P = 7.18 \text{ kN}$

$S1 = 7.2 / (0.68 \times 0.90 \times 0.30) = 39.11 \Rightarrow p \text{ average}$



$P = Ho = 1.32$
 $Mo = 2.55$

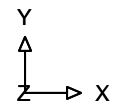
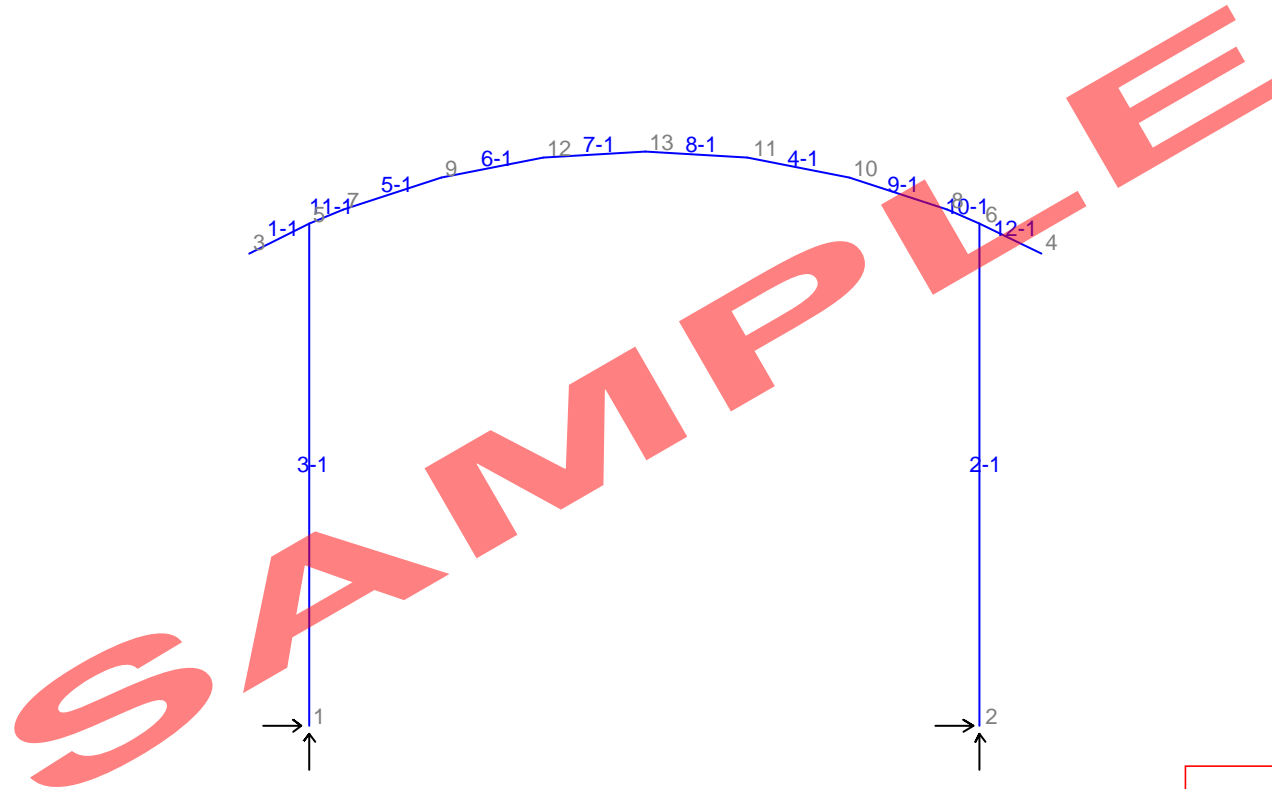
$pa = 1.5 \times 39.11 = 58.67 < p_{max} \text{ ok}$

ADOPT : 300 DIAM. PIER x ~~900~~ **1000** DEEP

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Sections:

— 1 75X50X2.0RHS Y



theta: 270 phi: 0

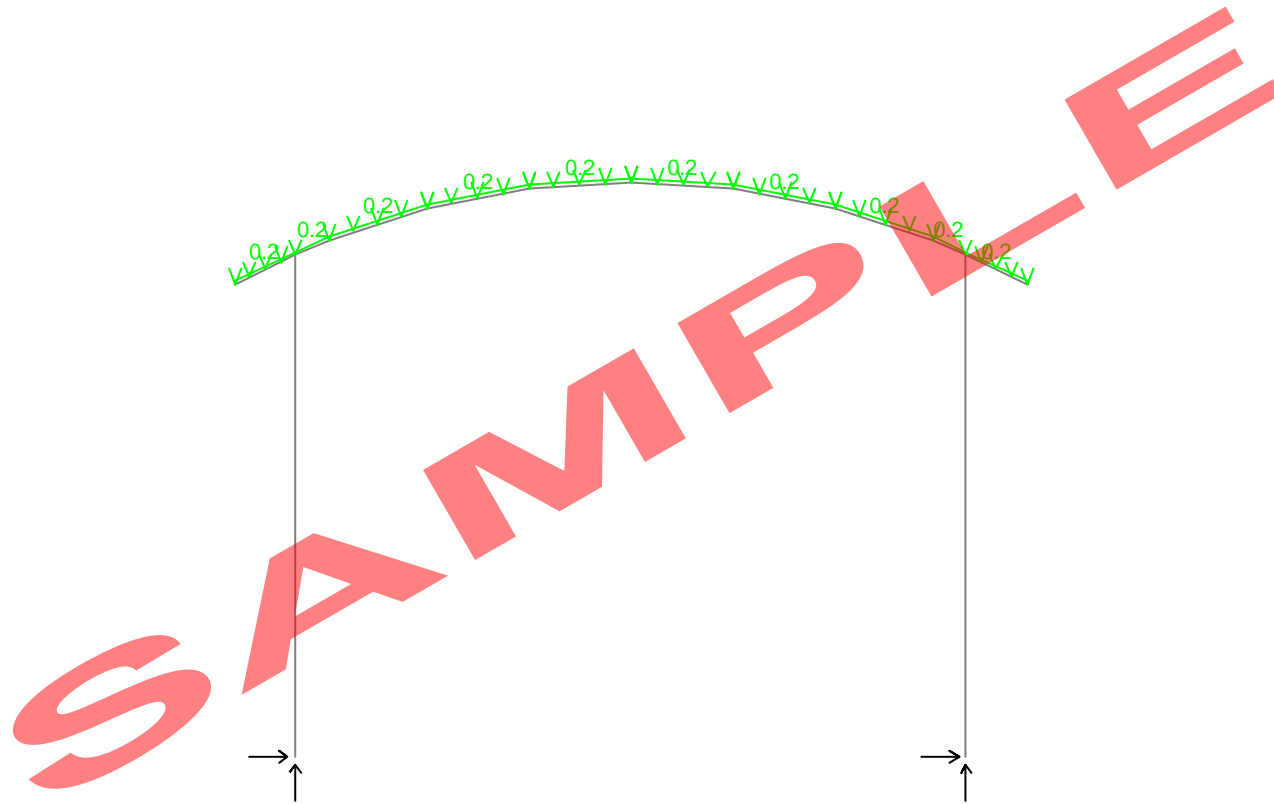
Design Geometry

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Load Cases:

101 P DL



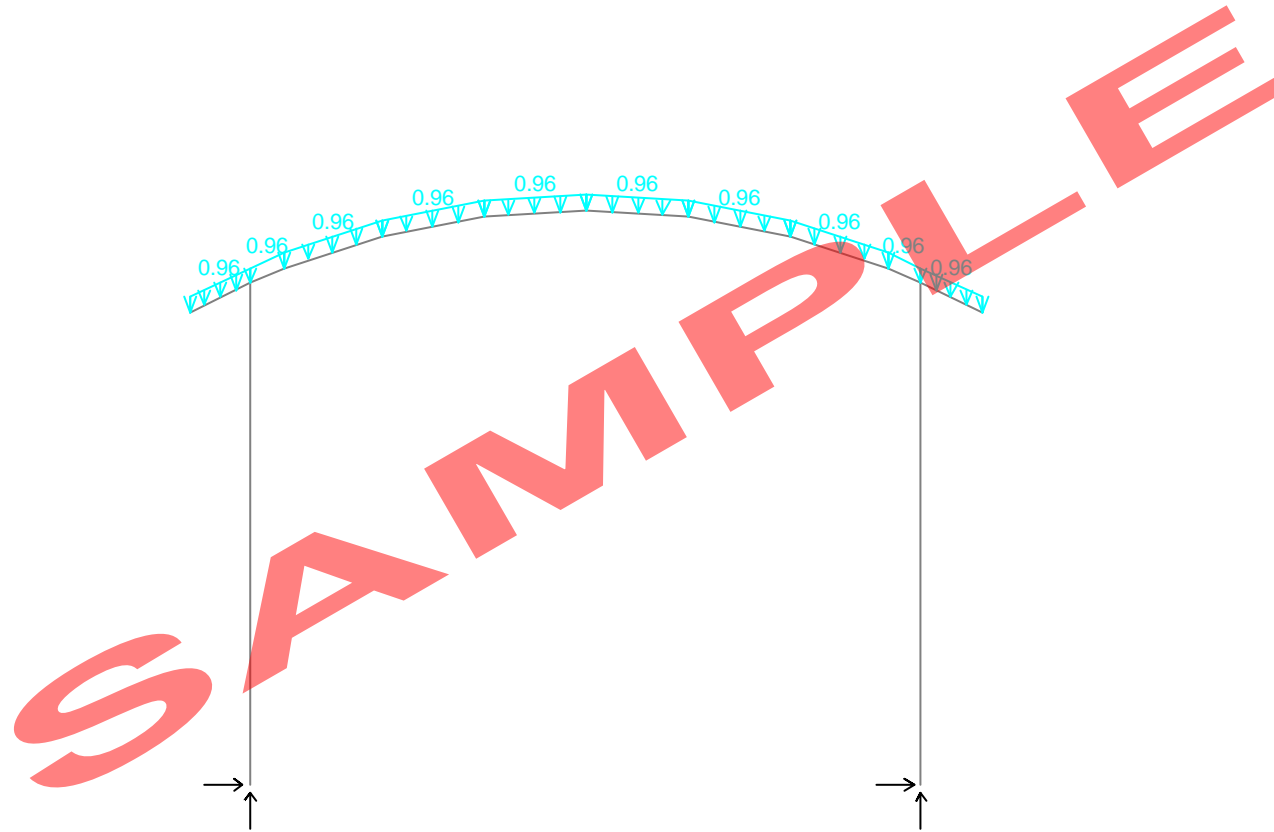
Y
↑
Z → X
theta: 270 phi: 0

Applied Loads

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Load Cases:

201 P LL



Y
↑
Z → X
theta: 270 phi: 0

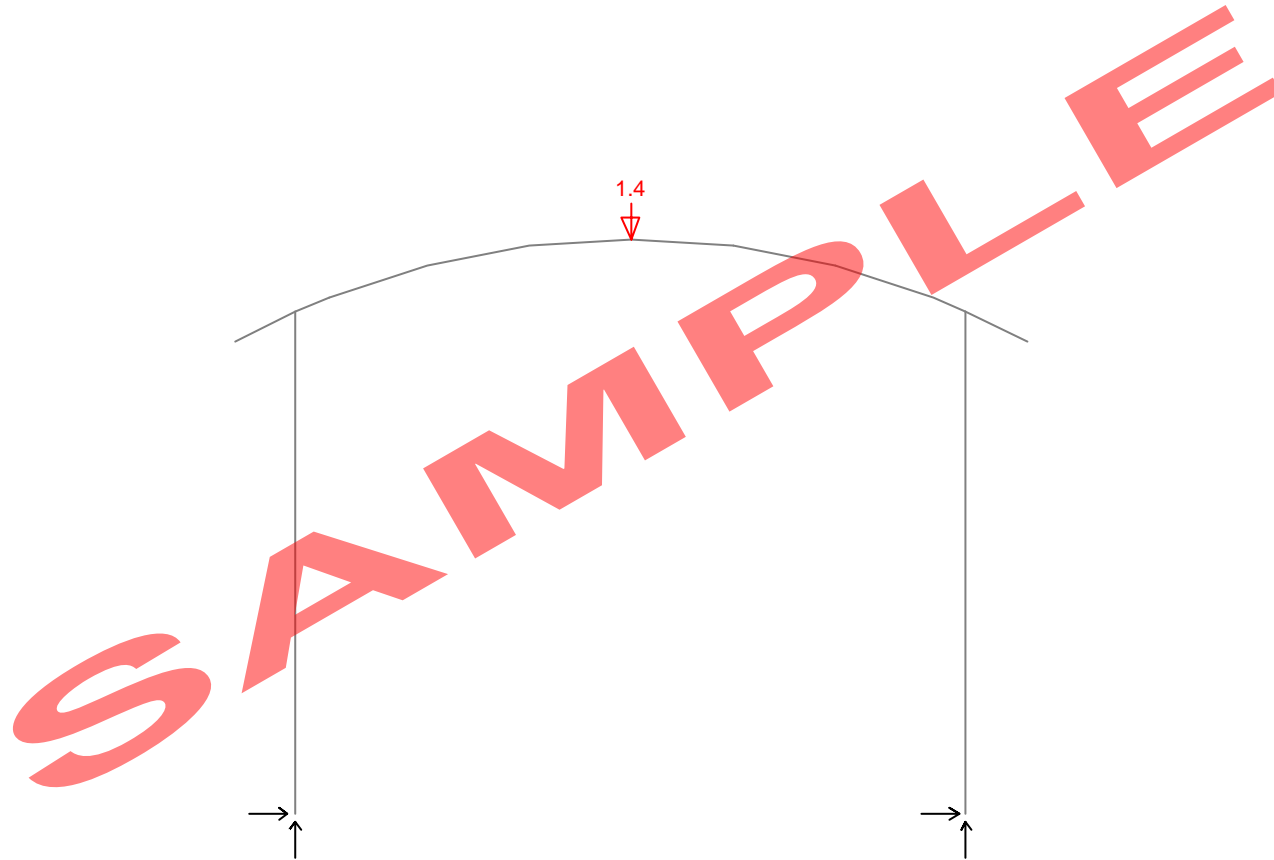
Applied Loads

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Load Cases:

— 202 P OPL



Y
↑
Z → X
theta: 270 phi: 0

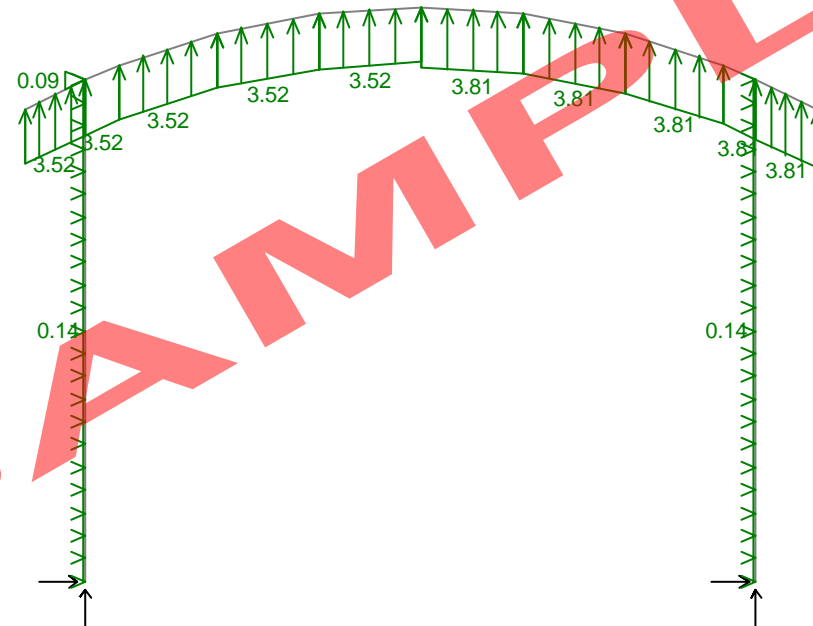
Applied Loads

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Load Cases:

— 301 P WP1 THETA = 0 DEG {.. CPE ..}



Y
↑
Z → X
theta: 270 phi: 0

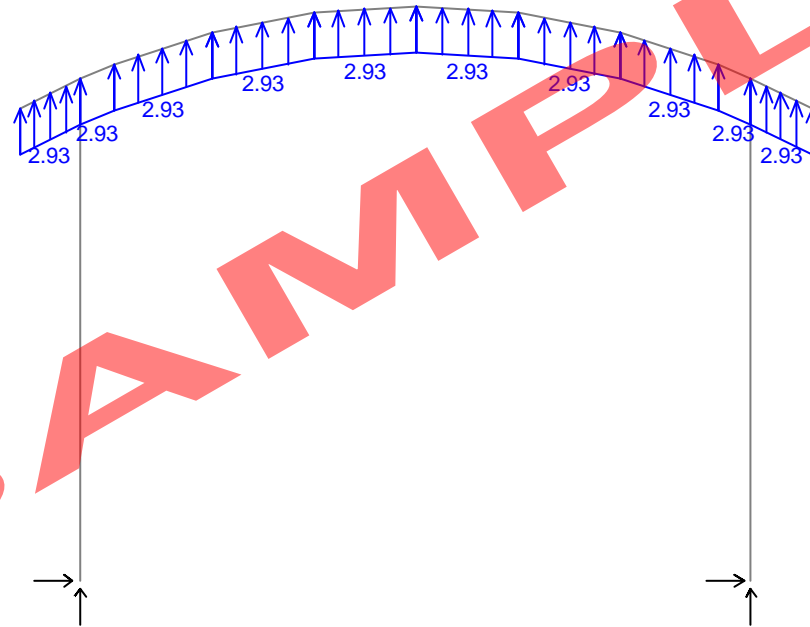
Applied Loads

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Load Cases:

— 302 P WP2 THETA = 90 DEG {.. CPE ..}



Y
↑
Z → X
theta: 270 phi: 0

Applied Loads

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Envelope for Axial Force

— Maximum

— Minimum

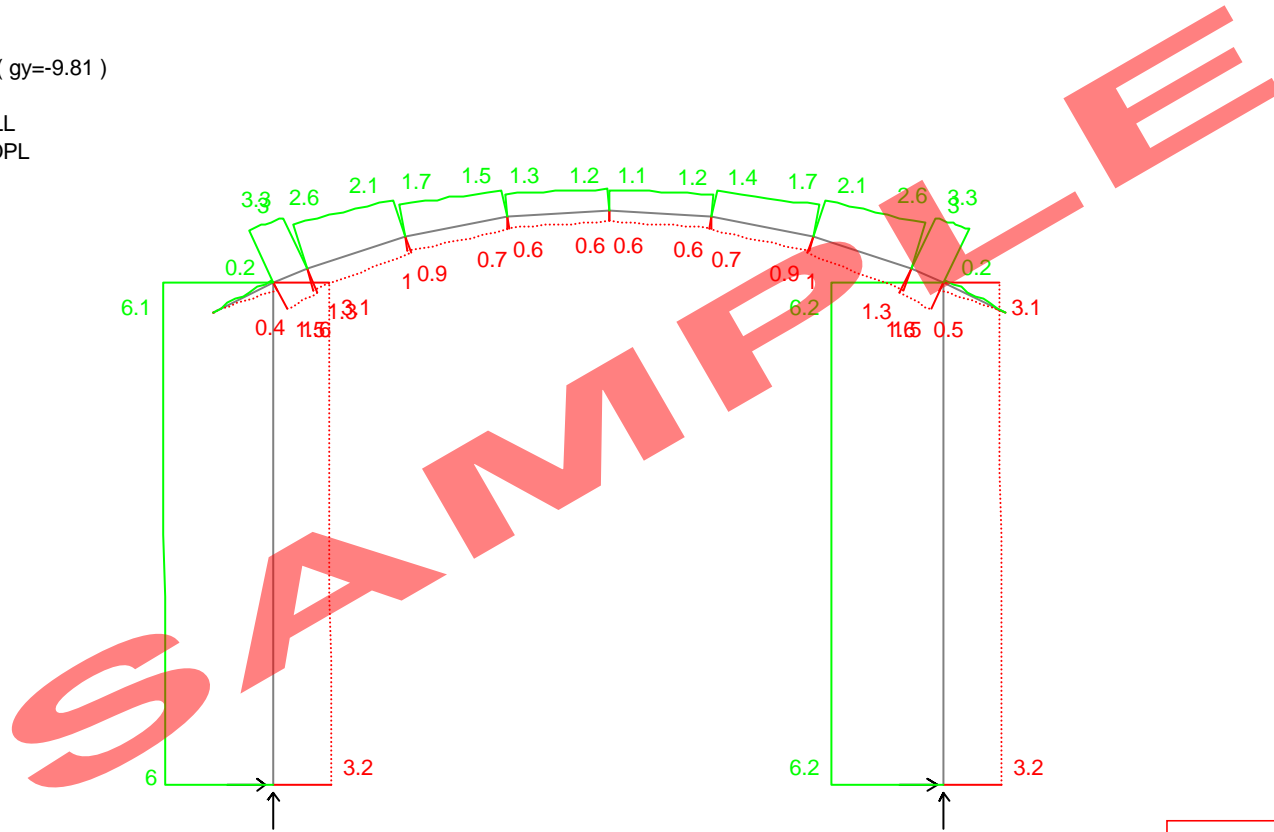
Enveloped Cases:

1500 C TOTAL 0.8(DL + Swt) + Wu1 (gy=-9.81)

1510 C TOTAL 0.8(DL + Swt) + Wu2

1520 C TOTAL 1.25(DL + Swt) + 1.5 LL

1521 C TOTAL 1.25(DL + Swt) + 1.5 OPL



Y
↑
Z → X
theta: 270 phi: 0

Axial Envelope

Axial Force, Fx

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Envelope for Shear Fy

— Maximum

— Minimum

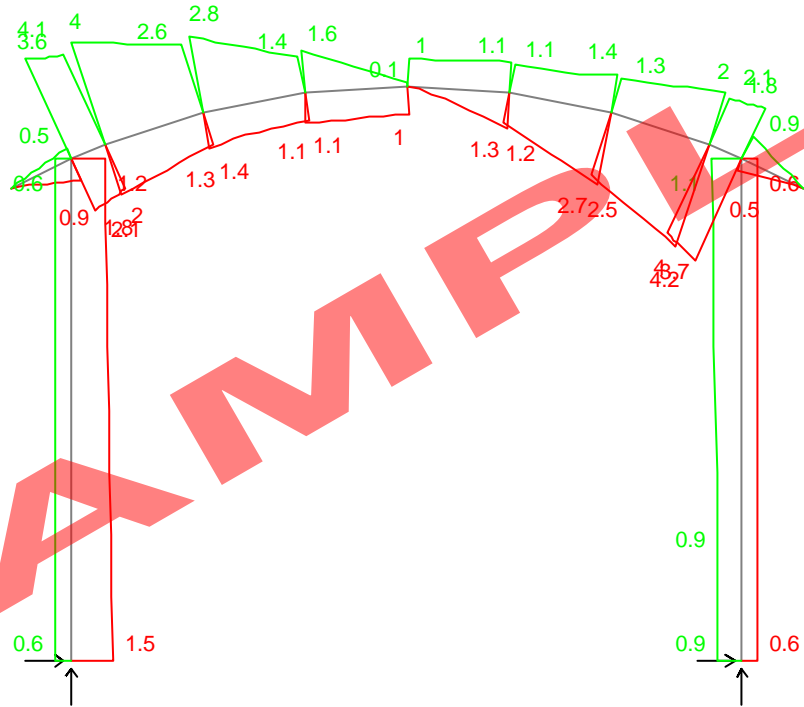
Enveloped Cases:

1500 C TOTAL 0.8(DL + Swt) + Wu1 (gy=-9.81)

1510 C TOTAL 0.8(DL + Swt) + Wu2

1520 C TOTAL 1.25(DL + Swt) + 1.5 LL

1521 C TOTAL 1.25(DL + Swt) + 1.5 OPL



SAMPLE

Y
↑
Z → X
theta: 270 phi: 0

Shear Envelope

Shear Force, Fy

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Envelope for Moment Mz

— Maximum

— Minimum

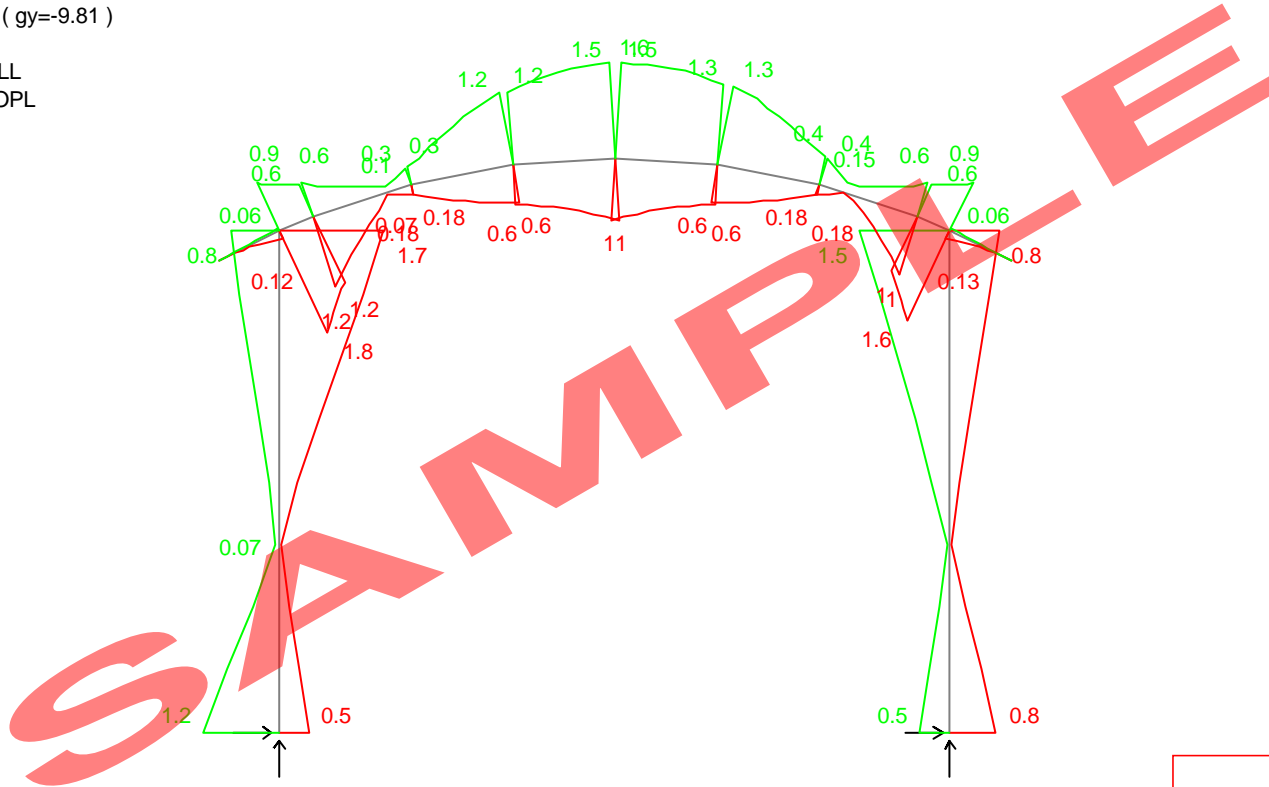
Enveloped Cases:

1500 C TOTAL 0.8(DL + Swt) + Wu1 (gy=-9.81)

1510 C TOTAL 0.8(DL + Swt) + Wu2

1520 C TOTAL 1.25(DL + Swt) + 1.5 LL

1521 C TOTAL 1.25(DL + Swt) + 1.5 OPL



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Y
↑
Z → X
theta: 270 phi: 0

Moment Envelope

Bending Moment, Mz

LOAD CASES - STEEL DESIGN

Case	Type	Title
1500	C	TOTAL 0.8(DL + Swt) + Wu1
1510	C	TOTAL 0.8(DL + Swt) + Wu2
1520	C	TOTAL 1.25(DL + Swt) + 1.5 LL
1521	C	TOTAL 1.25(DL + Swt) + 1.5 OPL

STEEL MEMBERS SUMMARY REPORT

Memb	Code	Length	Grade	Section	Crit. Ratio	Load Case	Critical Condition
		mm		Name			
1*	AS4100	3538	C350	<u>75X50X2.0RHS</u>	2.007	1500	Member out-plane C+Mx
2	AS4100	2149	C350	<u>75X50X2.0RHS</u>	2.569	1500	Section N+Mx
3	AS4100	2149	C350	75X50X2.0RHS	2.229	1500	Section N+Mx

LOAD CASES - STEEL DESIGN

Case	Type	Title
1500	C	TOTAL 0.8(DL + Swt) + Wu1
1510	C	TOTAL 0.8(DL + Swt) + Wu2
1520	C	TOTAL 1.25(DL + Swt) + 1.5 LL
1521	C	TOTAL 1.25(DL + Swt) + 1.5 OPL

STEEL MEMBERS FULL REPORT

MEMBER: 1 (Code Check to AS4100)(10 members, 1-11-5....9-10-12 linked)

Section: 75X50X2.0RHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D=	75.0	B=	50.0	T=	2.0
Ag=	474.0	rx=	28.0	Zx=	9.91E+03
		ry=	20.5	Zy=	7.96E+03
		J=	4.14E+05	Iw=	0.00E+00
		Sx=		Sy=	9.06E+03

Section Properties for Design:

Form Factor=	0.971	Class Mx:	Compact	Zex=	1.200E+04
Ae=	460	Class My:	Slender	Zey=	7.580E+03

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	3.538	L	L	N					

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

Critical conditions for design load cases:

Case	Cap/Load	Condition
1500	<u>2.007</u>	Member out-plane C+Mx
1510	<u>2.710</u>	Member out-plane C+Mx
1520	<u>3.467</u>	Member out-plane C+Mx
1521	<u>3.266</u>	Member out-plane C+Mx

SECTION CHECKS

Case: 1500 Off: 287 Cap/Load= 2.078 Section N+Mx (8.3.2)

Design loads:	N*= 3.25 t	M*x= 1.82	M*y= 0.00
Design capacities	øNt= 149.31	øMsx= 3.78	øMsy= 2.39
	øNs= 0.00	øMrx= 3.78	øMry= 2.34

MEMBER/SEGMENT CHECKS

Case: 1500 Off: 0/3538 Cap/Load= 2.007 Member out-plane C+Mx

Design loads:	N*= <u>0.45 c</u>	M*x= <u>1.82</u>	M*y= 0.00
Lmx= 3538	column o/a length	ßmx= -1.000	
Lmy= 3538		ßmy= 0.000	
Lx= 3538		ßme= 0.003	
Ly= 3538		øm= 1.902	BM modification factor

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Le= 3538 beam eff. length αs= 0.96 BM slend. reductn. factor
 Lz= 3538 torsion eff. length Transversely loaded.

Design capacities

∅Ncx= 47.37 ∅Msx= 3.78 ∅Ncy= 47.37 # ∅Mox= 3.72
 ∅Ncy= 26.42 ∅Mrx= 3.78 ∅Ncy= 26.42 # ∅Mbxo= 0.00
 ∅Msy= 2.39 ∅Mix= 3.74 ∅Noz= 0.00
 ∅Mry= 2.38 ∅Miy= 2.35 ∅Mcy= 3.72
 ∅Mbx= 3.78 # computed with kL ≤ Lm (8.4.2.2)

SHEAR CHECKS (Appendix I excluded)

Case: 1500 Off: 3252 Cap/Load= 12.867 Section N+Mx (8.3.2)

Design loads: V*= 4.17

Design capacities

∅Vv= 53.68 ∅Mf= 2.30

MEMBER: 2 (Code Check to AS4100)

Section: 75X50X2.0RHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D= 75.0 B= 50.0 T= 2.0
 Ag= 474.0 rx= 28.0 Zx= 9.91E+03 Sx= 1.20E+04
 ry= 20.5 Zy= 7.96E+03 Sy= 9.06E+03
 J= 4.14E+05 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 0.971 Class Mx: Compact Zex= 1.200E+04
 Ae= 460 Class My: Slender Zey= 7.580E+03

Member Restraints

No	Offset	/--Beam--/			Cant	Ht	/-----Column-----/			
		Top	Btm				XX	kx	YY	ky
1	0.000	L	L	N	S	Y	1.00	Y	1.00	
2	2.149	L	L	N						

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

Critical conditions for design load cases:

Case	Cap/Load	Condition
1500	2.569	Section N+Mx
1510	3.037	Section N+Mx
1520	3.867	Member out-plane C+Mx
1521	5.022	Member out-plane C+Mx

SECTION CHECKS

Case: 1500 Off: 2149 Cap/Load= 2.569 Section N+Mx (8.3.2)

Design loads: N*= 6.23 t M*x= -1.47 M*y= 0.00
 Design capacities ∅Nt= 149.31 ∅Msx= 3.78 ∅Msy= 2.39
 ∅Ns= 0.00 ∅Mrx= 3.78 ∅Mry= 2.29

MEMBER/SEGMENT CHECKS

Case: 1500 Off: 0/2149 Cap/Load= 2.570 Section N+Mx (8.3.2)

Design loads: N*= 6.23 t M*x= -1.47 M*y= 0.00

Lmx= 2149 column o/a length βmx= 1.000
 Lmy= 2149 βmy= 0.000
 Lx= 2149 βme= 0.454
 Ly= 2149 αm= 2.500 BM modification factor
 Le= 2149 beam eff. length αs= 0.99 BM slend. reductn. factor
 Lz= 2149 torsion eff. length Transversely loaded.

Design capacities

∅Nt= 149.31 ∅Msx= 3.78 ∅Mbx= 3.78 ∅Mox= 3.78
 ∅Mrx= 3.78 ∅Mix= 0.00 ∅Mbxo= 0.00
 ∅Msy= 2.39 ∅Miy= 0.00 ∅Noz= 0.00
 ∅Mry= 2.29 ∅Mcy= 0.00

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SHEAR CHECKS (Appendix I excluded)

Case: 1500 Off: 2149 Cap/Load= 46.838 Section N+Mx (8.3.2)

Design loads: V*= 1.15

Design capacities

øVv= 53.68 øMf= 2.30

MEMBER: 3 (Code Check to AS4100)

Section: 75X50X2.0RHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D= 75.0 B= 50.0 T= 2.0
 Ag= 474.0 rx= 28.0 Zx= 9.91E+03 Sx= 1.20E+04
 ry= 20.5 Zy= 7.96E+03 Sy= 9.06E+03
 J= 4.14E+05 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 0.971 Class Mx: Compact Zex= 1.200E+04
 Ae= 460 Class My: Slender Zey= 7.580E+03

Member Restraints

No	Offset	/--Beam--/				Ht	/-----Column-----/			
		Top	Btm	Cant			XX	kx	YY	ky
1	0.000	L	L	N	S	Y	1.00	Y	1.00	
2	2.149	L	L	N						

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

Critical conditions for design load cases:

Case	Cap/Load	Condition
1500	2.229	Section N+Mx
1510	3.037	Section N+Mx
1520	3.867	Member out-plane C+Mx
1521	5.022	Member out-plane C+Mx

SECTION CHECKS

Case: 1500 Off: 2149 Cap/Load= 2.229 Section N+Mx (8.3.2)

Design loads: N*= 6.08 t M*x= 1.70 M*y= 0.00

Design capacities øNt= 149.31 øMsx= 3.78 øMsy= 2.39
 øNs= 0.00 øMrx= 3.78 øMry= 2.29

MEMBER/SEGMENT CHECKS

Case: 1500 Off: 0/2149 Cap/Load= 2.230 Section N+Mx (8.3.2)

Design loads: N*= 6.08 t M*x= 1.70 M*y= 0.00

Lmx= 2149 column o/a length βmx= 0.380
 Lmy= 2149 βmy= 0.000
 Lx= 2149 βme= 0.735
 Ly= 2149 αm= 2.500 BM modification factor
 Le= 2149 beam eff. length αs= 0.99 BM slend. reductn. factor
 Lz= 2149 torsion eff. length Transversely loaded.

Design capacities

øNt= 149.31 øMsx= 3.78 øMbx= 3.78 øMox= 3.78
 øMrx= 3.78 øMix= 0.00 øMbxo= 0.00
 øMsy= 2.39 øMiy= 0.00 øNoz= 0.00
 øMry= 2.29 øMcy= 0.00

SHEAR CHECKS (Appendix I excluded)

Case: 1500 Off: 0 Cap/Load= 35.323 Section N+Mx (8.3.2)

Design loads: V*= 1.52

Design capacities

øVv= 53.68 øMf= 2.30

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SAMPLE

APPENDIX – A

EXAMPLE

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Queries relating to these computations should be directed to Roy Harrison

INPUT/ANALYSIS REPORT

Job: c1004frm

Title: Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m,
by S C Harrison

Type: Plane frame

Date: 2 Oct 2001

Time: 9:22 PM

Nodes 13
 Members 12
 Spring supports 0
 Sections 1
 Materials 1
 Primary load cases 6
 Combination load cases 12

Analysis: Non-linear elastic
 Update node coordinates Y
 Small displacement theory Y
 Include axial force effects Y
 Include flexural shortening N
 Convergence criterion: Residual
 Convergence tolerance 5.000E-04

LOAD CASES

Case	Type	Analysis	Title
100	P	L	SWT
101	P	L	DL
201	P	L	LL
202	P	L	OPL
301	P	L	WP1 THETA = 0 DEG {... CPE ...}
302	P	L	WP2 THETA = 90 DEG {... CPE ...}
900	C	L	TOTAL DL + Swt + Wp1
910	C	L	TOTAL DL + Swt + Wp2
920	C	L	TOTAL DL + Swt + LL
921	C	L	TOTAL DL + Swt + OPL
1000	C	L	TOTAL DL + Swt + Ws1
1010	C	L	TOTAL DL + Swt + Ws2
1020	C	L	TOTAL DL + Swt + LL
1021	C	L	TOTAL DL + Swt + OPL
1500	C	N	TOTAL 0.8(DL + Swt) + Wu1
1510	C	N	TOTAL 0.8(DL + Swt) + Wu2
1520	C	N	TOTAL 1.25(DL + Swt) + 1.5 LL
1521	C	N	TOTAL 1.25(DL + Swt) + 1.5 OPL

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

NODE COORDINATES

Node	X m	Y m	Z m	Restraint
1	0.000	0.000	0.000	111111
2	2.875	0.000	0.000	111111
3	-0.259	2.027	0.000	000000
4	3.134	2.027	0.000	000000
5	0.000	2.149	0.000	000000
6	2.875	2.149	0.000	000000
7	0.141	2.215	0.000	000000
8	2.734	2.215	0.000	000000
9	0.562	2.352	0.000	000000
10	2.313	2.352	0.000	000000
11	1.879	2.434	0.000	000000

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12	0.996	2.434	0.000	000000
13	1.438	2.462	0.000	000000

MEMBER DEFINITION

Member	A	B	C	Prop	Matl	Rel-A	Rel-B	Length
								m
1	3	5	Y	1	1	000000	000000	0.287
2	2	6	-X	1	1	000000	000000	2.149
3	1	5	-X	1	1	000000	000000	2.149
4	11	10	Y	1	1	000000	000000	0.442
5	7	9	Y	1	1	000000	000000	0.442
6	9	12	Y	1	1	000000	000000	0.442
7	12	13	Y	1	1	000000	000000	0.442
8	13	11	Y	1	1	000000	000000	0.442
9	10	8	Y	1	1	000000	000000	0.442
10	8	6	Y	1	1	000000	000000	0.156
11	5	7	Y	1	1	000000	000000	0.156
12	6	4	Y	1	1	000000	000000	0.287

LIBRARY SECTIONS

Section	Library	Name	Axis	Comment
1	Asw.lib	75X50X2.0RHS	Y	default

SECTION PROPERTIES

Section	Ax	Ay	Az	J	Iy	Iz	fact
	m2	m2	m2	m4	m4	m4	
1	4.740E-04	0.000E+00	0.000E+00	4.140E-07	1.990E-07	3.720E-07	

MATERIAL PROPERTIES

Material	E	u	Density	Alpha
	kN/m2		t/m3	/deg C
1	2.000E+08	0.2500	7.850E+00	1.170E-05

TABLE OF QUANTITIES

MATERIAL 1

Section	Name	Length	Mass	Comment
		m	tonne	
1	75X50X2.0RHS	7.836	0.029	default
		-----	-----	
		7.836	0.029	

APPLIED LOADING

CASE 100: 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:	-0.286	FZ:	0.000
-----	-------	-----	--------	-----	-------

CASE 101: DL

Member Loads

Member	Form	T	A	S	F1	X1	F2
1	UNIF	FY	GL		-0.200		
4	UNIF	FY	GL		-0.200		
5	UNIF	FY	GL		-0.200		
6	UNIF	FY	GL		-0.200		
7	UNIF	FY	GL		-0.200		
8	UNIF	FY	GL		-0.200		

X2	EXAMPLE
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9	UNIF	FY	GL	-0.200
10	UNIF	FY	GL	-0.200
11	UNIF	FY	GL	-0.200
12	UNIF	FY	GL	-0.200

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -0.708 FZ: 0.000

CASE 201: LL

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
1	UNIF	FY	GL		-0.960			
4	UNIF	FY	GL		-0.960			
5	UNIF	FY	GL		-0.960			
6	UNIF	FY	GL		-0.960			
7	UNIF	FY	GL		-0.960			
8	UNIF	FY	GL		-0.960			
9	UNIF	FY	GL		-0.960			
10	UNIF	FY	GL		-0.960			
11	UNIF	FY	GL		-0.960			
12	UNIF	FY	GL		-0.960			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -3.397 FZ: 0.000

CASE 202: OPL

Node Loads

Node	X Force	Y Force	Z Force	X Moment	Y Moment	Z Moment
	kN	kN	kN	kNm	kNm	kNm
13	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 301: WP1 THETA = 0 DEG {.. CPE ..}

Node Loads

Node	X Force	Y Force	Z Force	X Moment	Y Moment	Z Moment
	kN	kN	kN	kNm	kNm	kNm
5	0.090	0.000	0.000	0.000	0.000	0.000

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
1	UNIF	FY	GL		3.520			
2	UNIF	FX	GL		0.140			
3	UNIF	FX	GL		0.140			
4	UNIF	FY	GL		3.810			
5	UNIF	FY	GL		3.520			
6	UNIF	FY	GL		3.520			
7	UNIF	FY	GL		3.520			
8	UNIF	FY	GL		3.810			
9	UNIF	FY	GL		3.810			
10	UNIF	FY	GL		3.810			
11	UNIF	FY	GL		3.520			
12	UNIF	FY	GL		3.810			

Sum of Applied Loads (Global Axes):

FX: 0.692 FY: 12.968 FZ: 0.000

CASE 302: WP2 THETA = 90 DEG {.. CPE ..}

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Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
1	UNIF	FY	GL		2.930			
4	UNIF	FY	GL		2.930			
5	UNIF	FY	GL		2.930			
6	UNIF	FY	GL		2.930			
7	UNIF	FY	GL		2.930			
8	UNIF	FY	GL		2.930			
9	UNIF	FY	GL		2.930			
10	UNIF	FY	GL		2.930			
11	UNIF	FY	GL		2.930			
12	UNIF	FY	GL		2.930			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 10.367 FZ: 0.000

CASE 900: TOTAL DL + Swt + Wp1

Load Combinations

Case	Factor	
100	1.000	SWT
101	1.000	DL
301	0.667	WP1 THETA = 0 DEG {... CPE ...}

Sum of Applied Loads (Global Axes):

FX: 0.461 FY: 7.656 FZ: 0.000

CASE 910: TOTAL DL + Swt + Wp2

Load Combinations

Case	Factor	
100	1.000	SWT
101	1.000	DL
302	0.667	WP2 THETA = 90 DEG {... CPE ...}

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 5.921 FZ: 0.000

CASE 920: TOTAL DL + Swt + LL

Load Combinations

Case	Factor	
100	1.000	SWT
101	1.000	DL
201	1.000	LL

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -4.391 FZ: 0.000

CASE 921: TOTAL DL + Swt + OPL

Load Combinations

Case	Factor	
100	1.000	SWT
101	1.000	DL
202	1.000	OPL

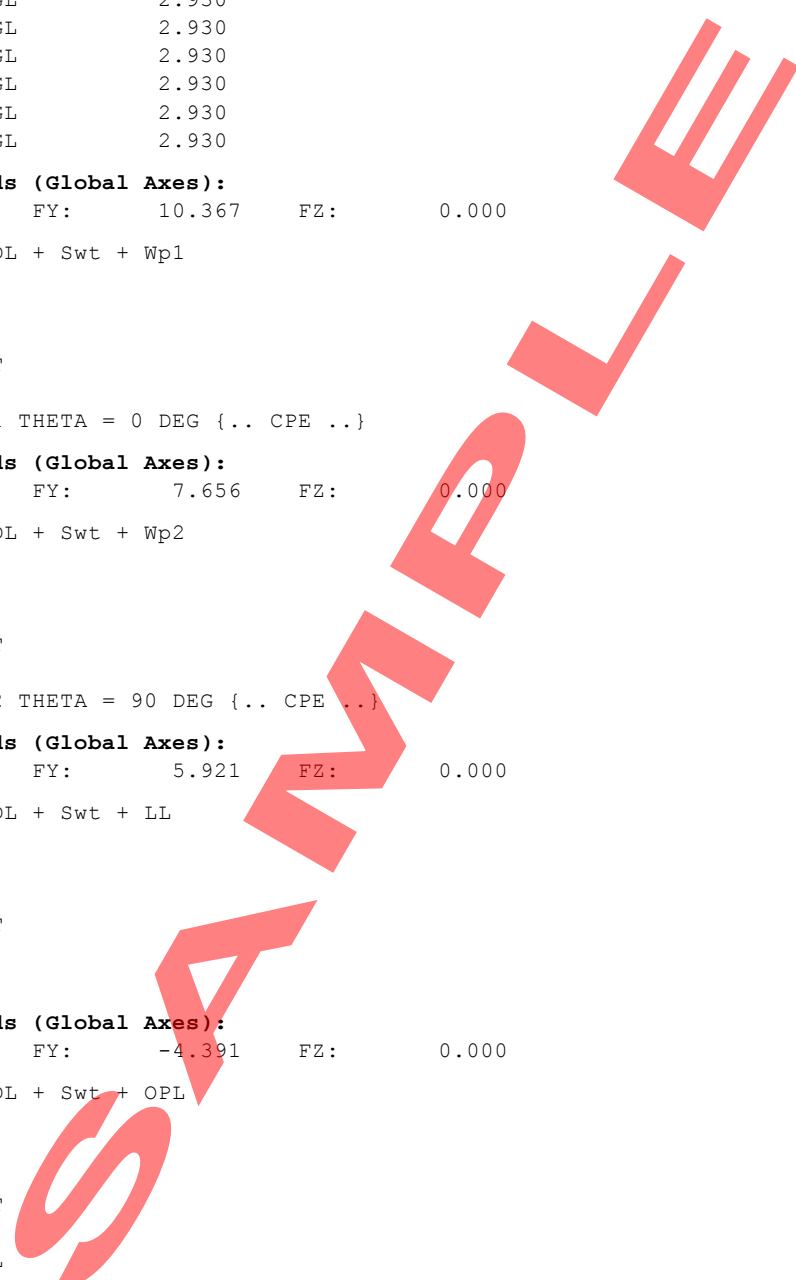
Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -2.394 FZ: 0.000

CASE 1000: TOTAL DL + Swt + Ws1

Load Combinations

Case	Factor	
100	1.000	SWT
101	1.000	DL
301	0.578	WP1 THETA = 0 DEG {... CPE ...}



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Sum of Applied Loads (Global Axes):

FX: 0.400 FY: 6.502 FZ: 0.000

CASE 1010: TOTAL DL + Swt + Ws2

Load Combinations

Case	Factor	
100	1.000	SWT
101	1.000	DL
302	0.578	WP2 THETA = 90 DEG {... CPE ...}

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 4.999 FZ: 0.000

CASE 1020: TOTAL DL + Swt + LL

Load Combinations

Case	Factor	
100	1.000	SWT
101	1.000	DL
201	0.700	LL

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -3.371 FZ: 0.000

CASE 1021: TOTAL DL + Swt + OPL

Load Combinations

Case	Factor	
100	1.000	SWT
101	1.000	DL
202	0.700	OPL

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -1.974 FZ: 0.000

CASE 1500: TOTAL 0.8(DL + Swt) + Wu1

Load Combinations

Case	Factor	
100	0.800	SWT
101	0.800	DL
301	1.000	WP1 THETA = 0 DEG {... CPE ...}

Sum of Applied Loads (Global Axes):

FX: 0.692 FY: 12.173 FZ: 0.000

CASE 1510: TOTAL 0.8(DL + Swt) + Wu2

Load Combinations

Case	Factor	
100	0.800	SWT
101	0.800	DL
302	1.000	WP2 THETA = 90 DEG {... CPE ...}

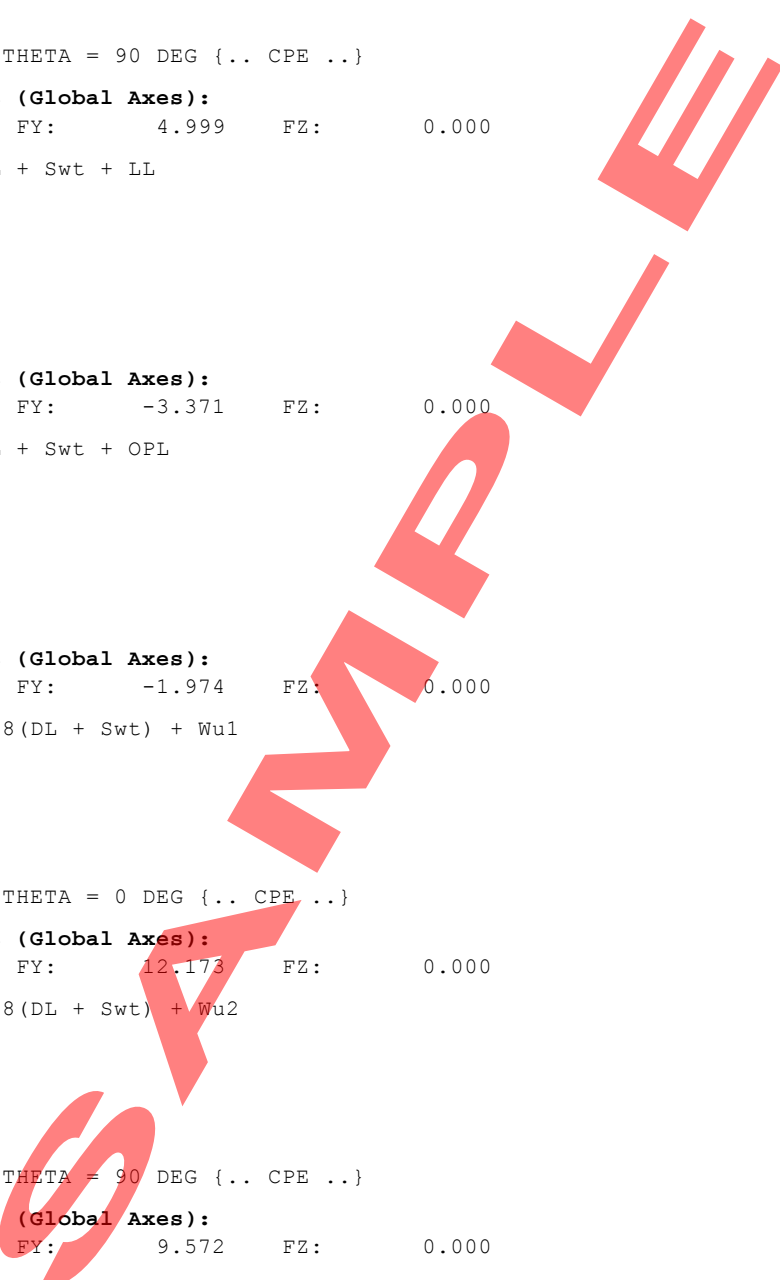
Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 9.572 FZ: 0.000

CASE 1520: TOTAL 1.25(DL + Swt) + 1.5 LL

Load Combinations

Case	Factor	
100	1.250	SWT
101	1.250	DL
201	1.500	LL



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Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -6.337 FZ: 0.000

CASE 1521: TOTAL 1.25(DL + Swt) + 1.5 OPL

Load Combinations

Case	Factor	
100	1.250	SWT
101	1.250	DL
202	1.500	OPL

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -3.342 FZ: 0.000

SAMPLE

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APPENDIX - B

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Queries relating to these computations should be directed to Roy Harrison

INPUT/ANALYSIS REPORT

Job: c1004frm

Title: : Curved Roof CarPort, 3m Wide x 2m Eaves Bays @3m,
by S C Harrison

Type: Plane frame

Date: 2 Oct 2001

Time: 9:27 PM

Nodes 13
Members 12
Spring supports 0
Sections 1
Materials 1
Primary load cases 6
Combination load cases 12

Analysis: Non-linear elastic

Update node coordinates Y
Small displacement theory Y
Include axial force effects Y
Include flexural shortening N
Convergence criterion: Residual
Convergence tolerance 5.000E-04

LOAD CASES

Case	Type	Analysis	Title
1500	C	N	TOTAL 0.8(DL + Swt) + Wu1
1510	C	N	TOTAL 0.8(DL + Swt) + Wu2
1520	C	N	TOTAL 1.25(DL + Swt) + 1.5 LL
1521	C	N	TOTAL 1.25(DL + Swt) + 1.5 OPL

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

MEMBER FORCES

CASE 1500: TOTAL 0.8(DL + Swt) + Wu1

Member	Node	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	3	0.000	0.000	0.000	0.000	0.000	0.000
	5	-0.413	-0.861	0.000	0.000	0.000	0.123
2	2	6.163	0.845	0.000	0.000	0.000	0.668
	6	<u>6.226</u>	1.146	0.000	0.000	0.000	-1.471
3	1	6.015	-1.520	0.000	0.000	0.000	-1.247
	5	6.077	-1.219	0.000	0.000	0.000	1.695
4	11	1.407	-1.166	0.000	0.000	0.000	-1.305
	10	1.725	-2.735	0.000	0.000	0.000	-0.443
5	7	2.563	3.988	0.000	0.000	0.000	1.215
	9	2.090	2.593	0.000	0.000	0.000	-0.241
6	9	1.746	2.836	0.000	0.000	0.000	-0.241
	12	1.453	1.392	0.000	0.000	0.000	-0.241
7	12	1.257	1.572	0.000	0.000	0.000	-0.241
	13	1.157	0.102	0.000	0.000	0.000	-0.241
8	13	1.133	0.256	0.000	0.000	0.000	-0.241
	11	1.240	-1.342	0.000	0.000	0.000	-1.305
9	10	2.059	-2.493	0.000	0.000	0.000	-0.443

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	8	2.574	-4.009	0.000	0.000	0.000	0.995
10	8	3.046	-3.664	0.000	0.000	0.000	0.995
	6	3.292	-4.172	0.000	0.000	0.000	1.605
11	5	3.254	4.114	0.000	0.000	0.000	<u>1.819</u>
	7	3.029	3.646	0.000	0.000	0.000	1.215
12	6	-0.450	0.935	0.000	0.000	0.000	0.134
	4	0.000	0.000	0.000	0.000	0.000	0.000

Positive Forces (Member Axes):

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

SUPPORT REACTIONS

CASE 1500: TOTAL 0.8(DL + Swt) + Wu1

Node	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
1	<u>-1.538</u>	<u>-6.010</u>	0.000	0.000	0.000	<u>1.247</u>
2	<u>0.847</u>	<u>-6.163</u>	0.000	0.000	0.000	<u>-0.668</u>

SUM: -0.692 -12.173 0.000 (all nodes)

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

MEMBER FORCES

CASE 1510: TOTAL 0.8(DL + Swt) + Wu2

Member	Node	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	3	0.000	0.000	0.000	0.000	0.000	0.000
	5	-0.339	-0.709	0.000	0.000	0.000	0.102
2	2	4.787	0.930	0.000	0.000	0.000	0.754
	6	<u>4.850</u>	0.930	0.000	0.000	0.000	-1.245
3	1	4.787	-0.930	0.000	0.000	0.000	-0.754
	5	4.850	-0.930	0.000	0.000	0.000	1.245
4	11	1.156	-1.005	0.000	0.000	0.000	-0.977
	10	1.394	-2.194	0.000	0.000	0.000	-0.270
5	7	2.047	3.149	0.000	0.000	0.000	0.869
	9	1.660	2.000	0.000	0.000	0.000	-0.270
6	9	1.394	2.194	0.000	0.000	0.000	-0.270
	12	1.156	1.005	0.000	0.000	0.000	-0.977
7	12	1.015	1.148	0.000	0.000	0.000	-0.977
	13	0.934	-0.062	0.000	0.000	0.000	-1.217
8	13	0.934	0.062	0.000	0.000	0.000	-1.217
	11	1.015	-1.148	0.000	0.000	0.000	-0.977
9	10	1.660	-2.000	0.000	0.000	0.000	-0.270
	8	2.047	-3.149	0.000	0.000	0.000	0.869
10	8	2.418	-2.874	0.000	0.000	0.000	0.869
	6	2.602	-3.258	0.000	0.000	0.000	1.346
11	5	2.602	3.258	0.000	0.000	0.000	<u>1.346</u>
	7	2.418	2.874	0.000	0.000	0.000	0.869
12	6	-0.339	0.709	0.000	0.000	0.000	0.102
	4	0.000	0.000	0.000	0.000	0.000	0.000

Positive Forces (Member Axes):

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

SUPPORT REACTIONS

CASE 1510: TOTAL 0.8(DL + Swt) + Wu2

Node	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
1	-0.937	-4.786	0.000	0.000	0.000	0.754
2	0.937	-4.786	0.000	0.000	0.000	-0.754

SUM: 0.000 -9.572 0.000 (all nodes)

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

MEMBER FORCES

CASE 1520: TOTAL 1.25(DL + Swt) + 1.5 LL

Member	Node	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	3	0.000	0.000	0.000	0.000	0.000	0.000
	5	0.210	0.451	0.000	0.000	0.000	-0.065
2	2	-3.168	-0.596	0.000	0.000	0.000	-0.487
	6	-3.070	-0.596	0.000	0.000	0.000	0.794
3	1	<u>-3.168</u>	0.596	0.000	0.000	0.000	0.487
	5	-3.070	0.596	0.000	0.000	0.000	-0.794
4	11	-0.723	0.647	0.000	0.000	0.000	0.630
	10	-0.862	1.402	0.000	0.000	0.000	0.177
5	7	-1.261	-2.016	0.000	0.000	0.000	-0.553
	9	-1.029	-1.284	0.000	0.000	0.000	0.177
6	9	-0.862	-1.402	0.000	0.000	0.000	0.177
	12	-0.723	-0.647	0.000	0.000	0.000	0.630
7	12	-0.638	-0.730	0.000	0.000	0.000	0.630
	13	-0.592	0.036	0.000	0.000	0.000	0.784
8	13	-0.592	-0.036	0.000	0.000	0.000	0.784
	11	-0.638	0.730	0.000	0.000	0.000	0.630
9	10	-1.029	1.284	0.000	0.000	0.000	0.177
	8	-1.261	2.016	0.000	0.000	0.000	-0.553
10	8	-1.506	1.840	0.000	0.000	0.000	-0.553
	6	-1.620	2.085	0.000	0.000	0.000	-0.858
11	5	-1.620	-2.085	0.000	0.000	0.000	-0.858
	7	-1.506	-1.840	0.000	0.000	0.000	-0.553
12	6	0.210	-0.451	0.000	0.000	0.000	-0.065
	4	0.000	0.000	0.000	0.000	0.000	0.000

Positive Forces (Member Axes):

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

SUPPORT REACTIONS

CASE 1520: TOTAL 1.25(DL + Swt) + 1.5 LL

Node	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
1	0.593	3.169	0.000	0.000	0.000	-0.487
2	-0.593	3.169	0.000	0.000	0.000	0.487

SUM: 0.000 6.337 0.000 (all nodes)

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

MEMBER FORCES

CASE 1521: TOTAL 1.25(DL + Swt) + 1.5 OPL

Member	Node	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	3	0.000	0.000	0.000	0.000	0.000	0.000
	5	0.036	0.077	0.000	0.000	0.000	-0.011
2	2	-1.671	-0.494	0.000	0.000	0.000	-0.406
	6	-1.573	-0.494	0.000	0.000	0.000	0.656
3	1	-1.671	0.494	0.000	0.000	0.000	0.406
	5	-1.573	0.494	0.000	0.000	0.000	-0.656
4	11	-0.699	1.072	0.000	0.000	0.000	0.525
	10	-0.723	1.200	0.000	0.000	0.000	0.525
5	7	-0.907	-1.225	0.000	0.000	0.000	0.525
	9	-0.867	-1.100	0.000	0.000	0.000	0.525
6	9	-0.723	-1.200	0.000	0.000	0.000	0.525
	12	-0.699	-1.072	0.000	0.000	0.000	0.525
7	12	-0.563	-1.149	0.000	0.000	0.000	0.525

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	13	-0.555	-1.018	0.000	0.000	0.000	1.004
8	13	-0.555	1.018	0.000	0.000	0.000	1.004
	11	-0.563	1.149	0.000	0.000	0.000	0.525
9	10	-0.867	1.100	0.000	0.000	0.000	0.022
	8	-0.907	1.225	0.000	0.000	0.000	-0.492
10	8	-1.055	1.100	0.000	0.000	0.000	-0.492
	6	-1.074	1.142	0.000	0.000	0.000	-0.667
11	5	-1.074	-1.142	0.000	0.000	0.000	-0.667
	7	-1.055	-1.100	0.000	0.000	0.000	-0.492
12	6	0.036	-0.077	0.000	0.000	0.000	-0.011
	4	0.000	0.000	0.000	0.000	0.000	0.000

Positive Forces (Member Axes):

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

SUPPORT REACTIONS

CASE 1521: TOTAL 1.25(DL + Swt) + 1.5 OPL

Node	Force-X	Force-Y	Force-Z	Moment-X	Moment-Y	Moment-Z
	kN	kN	kN	kNm	kNm	kNm
1	0.493	1.671	0.000	0.000	0.000	-0.406
2	-0.493	1.671	0.000	0.000	0.000	0.406
SUM:	0.000	3.342	0.000	(all nodes)		

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

EXAMPLE

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