
Structural Calculations

FOR

PROPOSED DOMESTIC CANOPY - VERANDAH

Report No: 985

October, 2001

**ROY HARRISON
& ASSOCIATES**
CONSULTING ENGINEERS

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Date: 16 October 2001

Project No: 985

Project: CANOPY/VERANDAH :

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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Appendices :

- A Microstran Analysis Input Data
- B Microstran Analysis Force Output - Pinned Rafters
- C Microstran Analysis Force Output - Fully Welded Design

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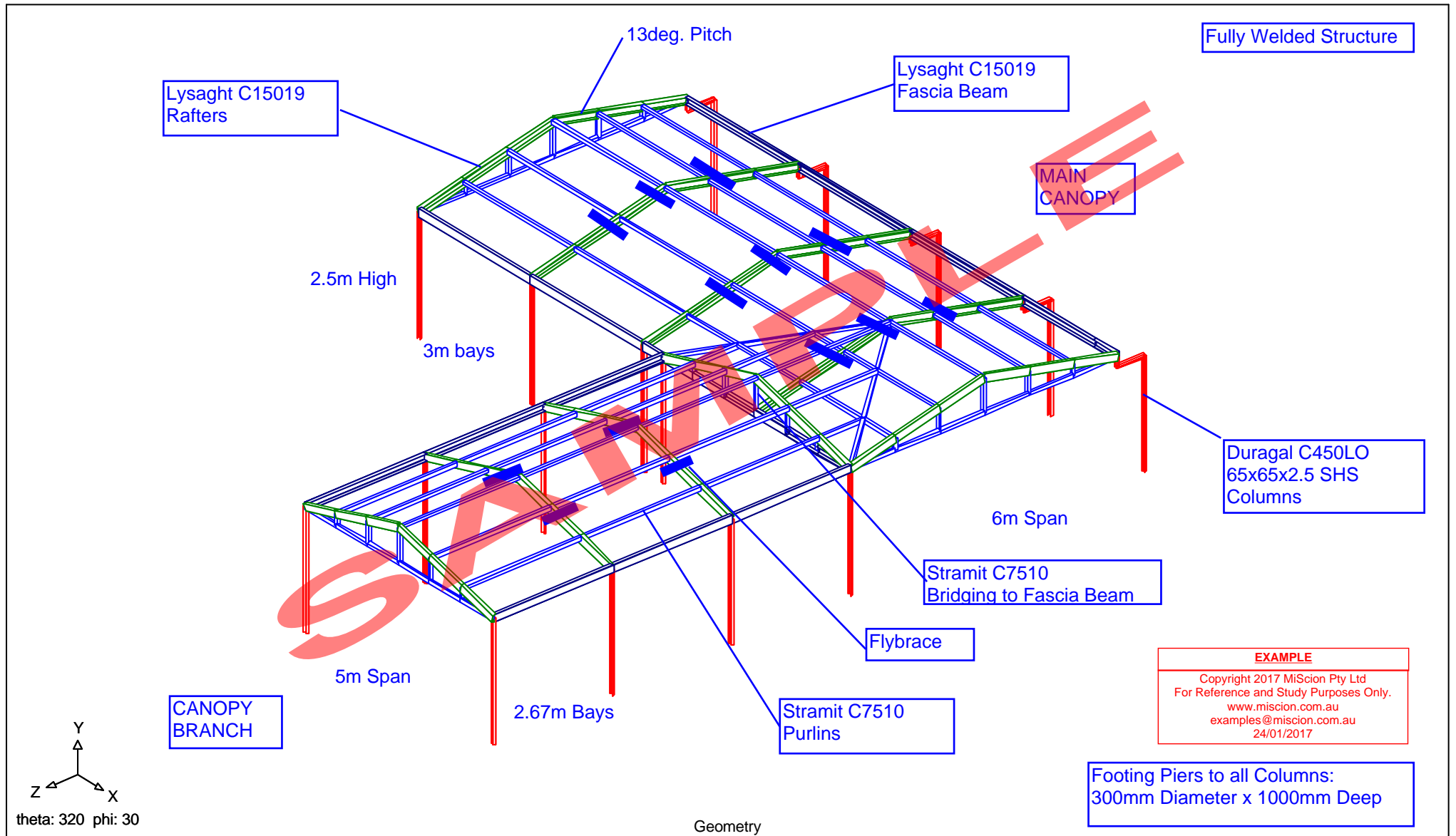
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SYNOPSIS

Main Design is for simple bolted connections of rafters at the eaves. The members and connections are then checked for suitability for use if fully welded construction is used.

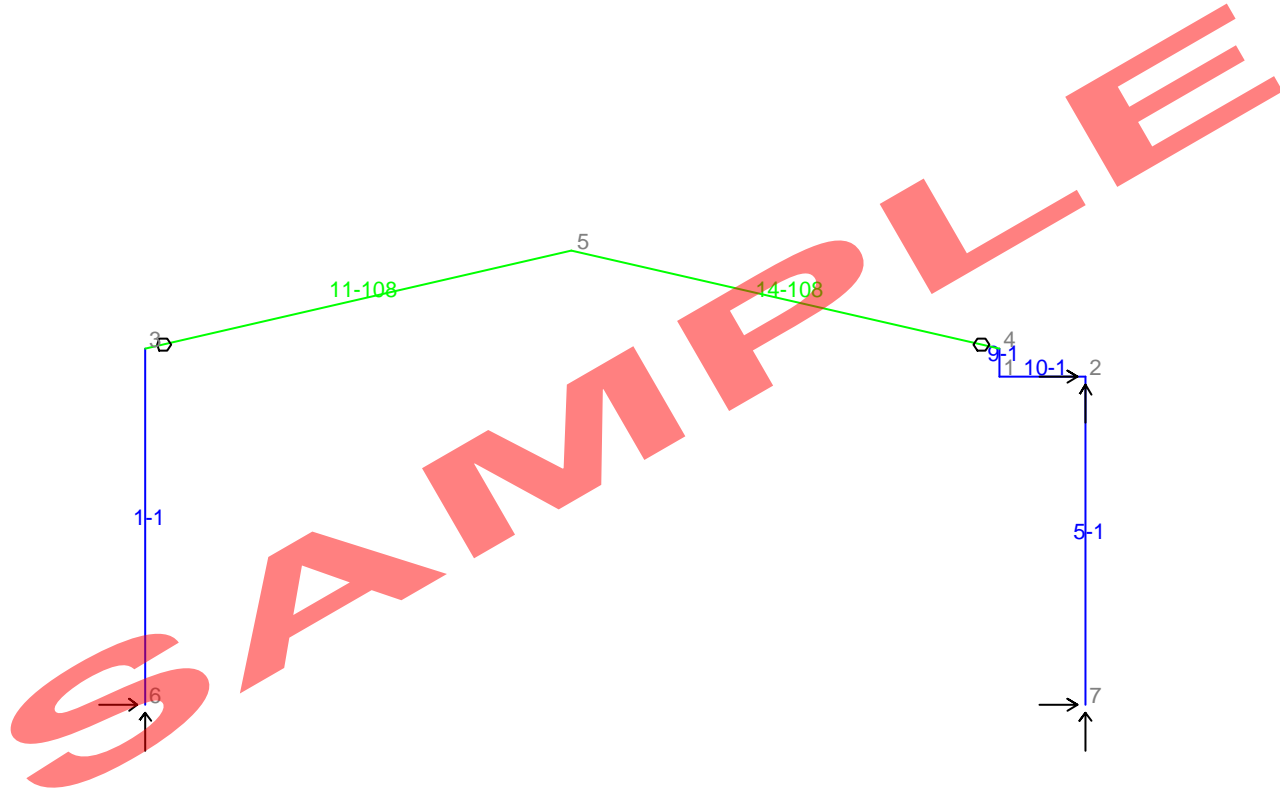
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Sections:

- 1 65X65X2.5SHS Y
- 108 C15019



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Design Geometry - Main Frame

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TITLE :
: Verandah, 6m Wide x 2.5m Eaves, TC3

FRAME LOADING

DEAD

Sheeting	0.04 kPa = kN/m ²		
Purlins/Girts	$\frac{0.02 \text{ kPa} = \text{kN/m}^2}{\sum \text{DL } 0.06 \text{ kPa}}$ x 3.000 =		0.18 kN/m
Swt Frame			0.04 kN/m
		$\sum \text{DL}$	<u>0.22 kN/m</u>

LIVE (Roof)

Projected Area of Portal Rafter A	=	3.00 x 6.00	
	=	18 m ²	
LL	=	(1.8/A + 0.12)	= 0.22 kPa
$\sum \text{LL}$	=	0.25 kPa x 3	= <u>0.75 kN/m</u>

OCCASSIONAL POINT LOAD (OPL)

Industrial	$\sum \text{OPI} =$	<u>1.4 kN</u>	Domestic
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SAMPLE

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TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Doubly Pitched Canopy

Alpha	13.0 degrees =	0.23 radians =	Pitch 1 in	4.33
Building Eaves Hght	2.5 m	Building Span		6 m
Bay Spacing	3 m	Number of Bays		4
Building Length	12 m	Number of Columns		10

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 =	0.42

Q = 0
 Wind Classification to AS1170
a < 60 h = he = 2.500 m

Tcat = 3 TC3.0
 M[z,cat] = 0.75
 M[s] = 0.85 FS
 M[t] = 1 T1
 M[i] = 1
 directional M[d] = 0.95

Q = 90
 Wind Classification to AS1170
 h = ht = 3.193 m

Tcat = 3 TC3.0
 M[z,cat] = 0.75
 M[s] = 0.85 FS
 M[t] = 1 T1
 M[i] = 1
 M[d] = 0.95

Vz =	Perm	Limit	
	30.0	30.3 m/s	
qz =	0.54	0.55 kPa	

Vz =	Perm	Limit	
	30.0	30.3 m/s	
qz =	0.54	0.55 kPa	

Wind Classification to AS4055
N1 WP28,WU34
 Vz = 28 34 m/s
 qz = 0.47 0.69 kPa

Wind Classification to AS4055
N1 WP28,WU34
 Vz = 28 34 m/s
 qz = 0.47 0.69 kPa

<u>Design</u>	<u>AS1170</u>	<u>Limit State</u>
Vz =	30.3 m/s	
qz =	0.55 kPa	
wz =	1.65 kN/m	

<u>Design</u>	<u>AS1170</u>	<u>Limit State</u>
Vz =	30.3 m/s	
qz =	0.55 kPa	
wz =	1.65 kN/m	

b = 6.00 m d = 12.00 m

local pressure extent = 'a' = min $\begin{matrix} 0.2 b \\ 0.2 d \\ ht \end{matrix}$ = 1.2 m

a/2 = 0.6 m

Length along Slope of Rafter = 3.079 m

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Area Reduction Factors

Tributary Area

			m ²	Ka
<u>Rafter</u>				
Aligned	6.158 x 3.000	=	18.47	0.94
Projected	6.000 x 3.000	=	18.00	0.95
<u>Column</u>				
Aligned	2.500 x 3.000	=	7.50	1.00

TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Doubly Pitched Canopy

Q = 0 Transverse



a < 60
 h = he = 2.500 m
 length b = 12.000 m
 span d = 6.000 m
 h/d = 0.42
 d/h = 2.40
 d/b = 0.50

State : Blocked Under

a =130	Cpw	Cpl
-ve	-1.2	-1.3
+ve		

Frictional Drag on Roof

F1 = 0.01 bd qz

√ F1 = smooth/parallel to ribs 0.40 kN
 2F1 = across corrugations 0.79 kN
 4F1 = across ribs 1.58 kN

Drag on Frame

Assume :

65.00 SHS column

Cd
1.30

ki	ksh
1.00	1.00

Fd = ki ksh kar Cd Az qz

l/b	Kar	Az m ²	Fd kN
Column	38.5	0.90	0.16
Rafter			0.10
			Σ 0.10

Column
Rafter

Q = 90 Longitudinal



h = ht = 3.193 m
 span b = 6.000 m
 length d = 12.000 m
 h/d = 0.27
 d/h = 3.76
 d/b = 2.00

State : Blocked Under

a =130	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 0.40 kN
 2F1 = across corrugations 0.79 kN
 √ 4F1 = across ribs 1.58 kN

Drag on Frame

Assume :

65.00 SHS column
 150.00 Channel Rafter

Cd
1.30
1.90

ki	ksh
1.00	1.00

Fd = ki ksh kar Cd Az qz

l/b	Kar	Az m ²	Fd kN
Column	38.5	0.90	0.16
Rafter	20.5	1.00	0.46
			Σ 0.59

Column
Rafter

Wind on Gable End {if present}

Cpw = 0.7
 Cpl = -0.5
 Cpn = 1.2

Full Rise of Roof = 0.693 m
 Area of Gable = 2.078 m²

Uplift

= bd Cpn qz
 Total = 51.5 kN
 6.4 kN/column

Uplift

= bd Cpn qz
 Total = 39.6 kN
 5.0 kN/column

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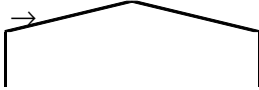
TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Doubly Pitched Canopy

Q = 0

Transverse



Loads on Single Frame supporting 1 bay

Drag Load Roof {1 bay}	0.10 kN @top col.
Drag on Windward Column	0.04 kN/m
Winward Roof	-1.87 kN/m
Leeward Roof	-2.03 kN/m
Drag on Leeward Column	0.04 kN/m

Q = 90

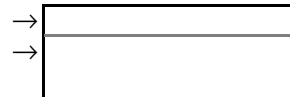
Longitudinal



Loads on Single Frame supporting 1 bay

Winward Roof	-1.56 kN/m
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Loads on Longitudinal Frame



Drag Load Roof {1 side}	0.79 kN
Drag on rafter	0.48 kN/rafter
Drag on Column	0.10 kN/column

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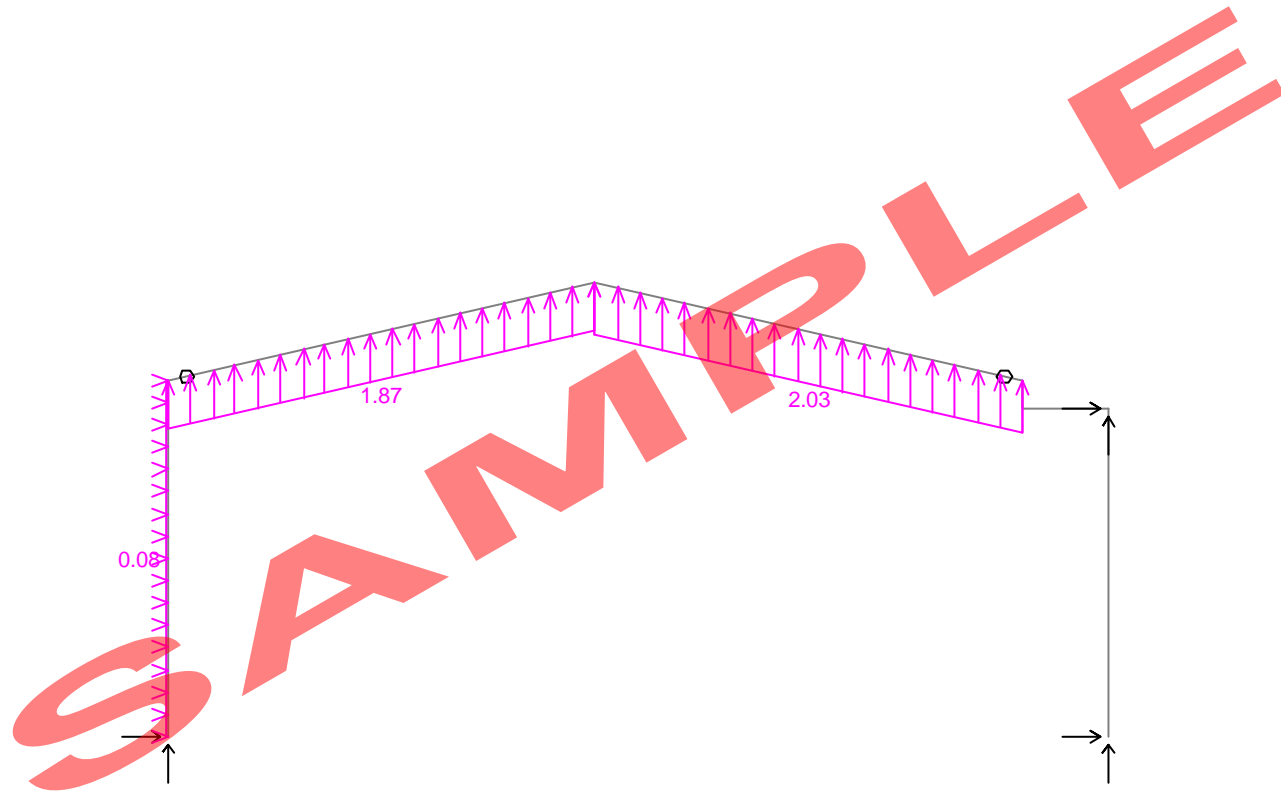
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Load Cases:

— 1 P Wind theta=0

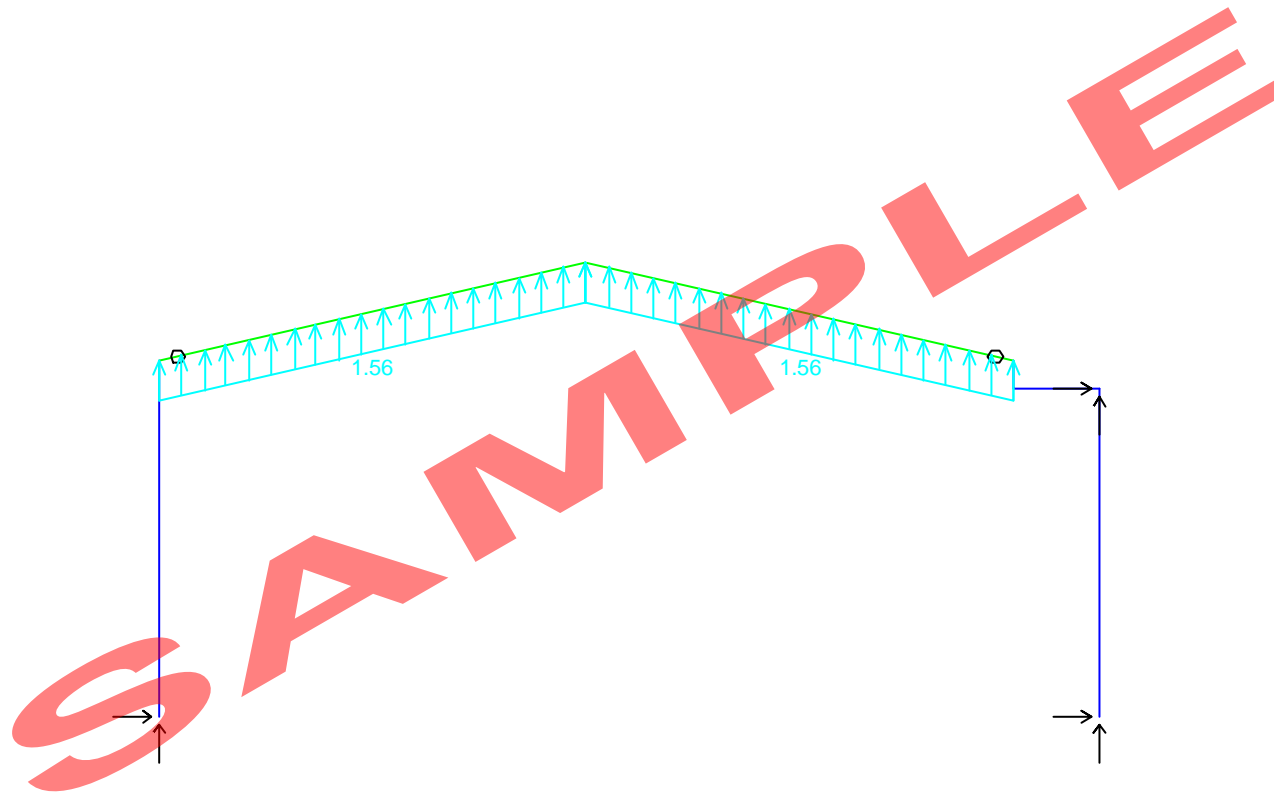


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theta: 270 phi: 0

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Wind Loading - Main Frame

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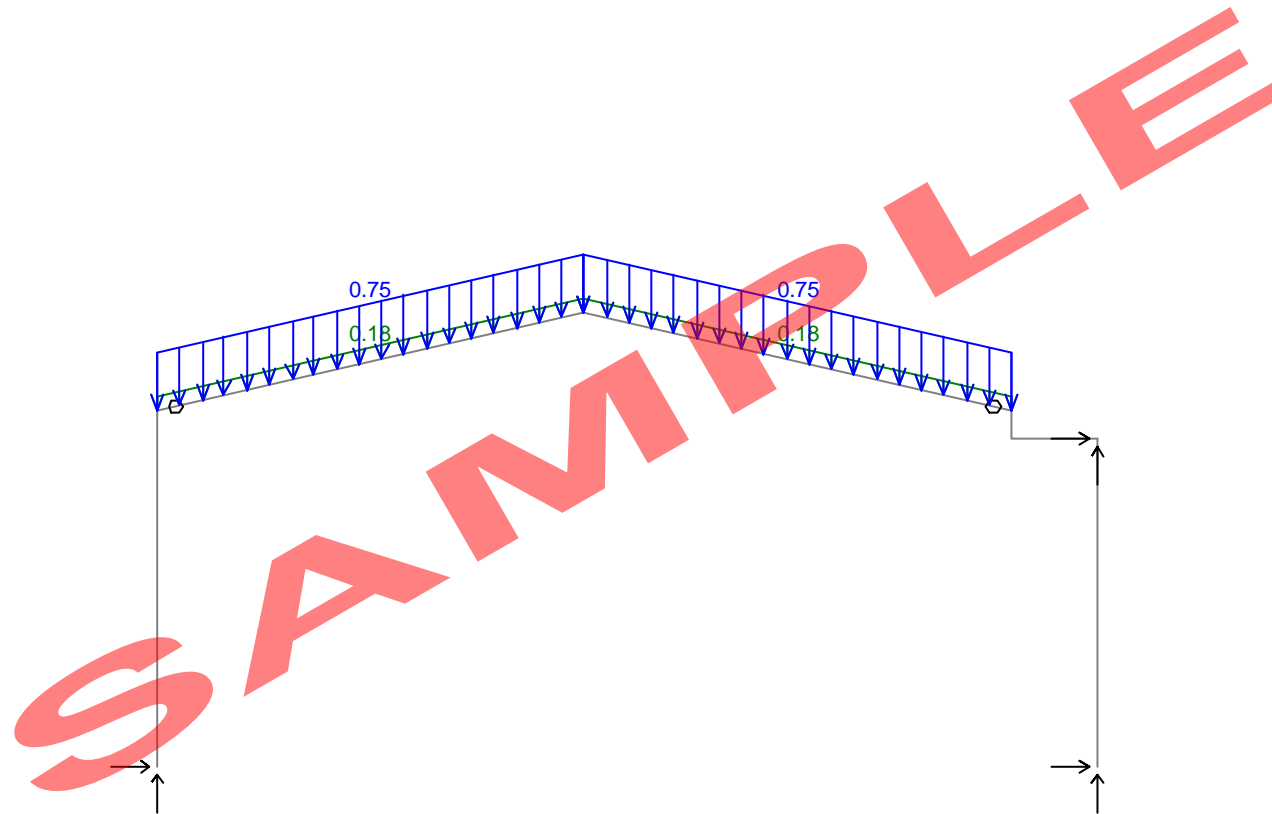
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Z → X
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Wind Loading - Main Frame

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- Load Cases:
- 5 P Deadloads
 - 6 P Liveloads



EXAMPLE

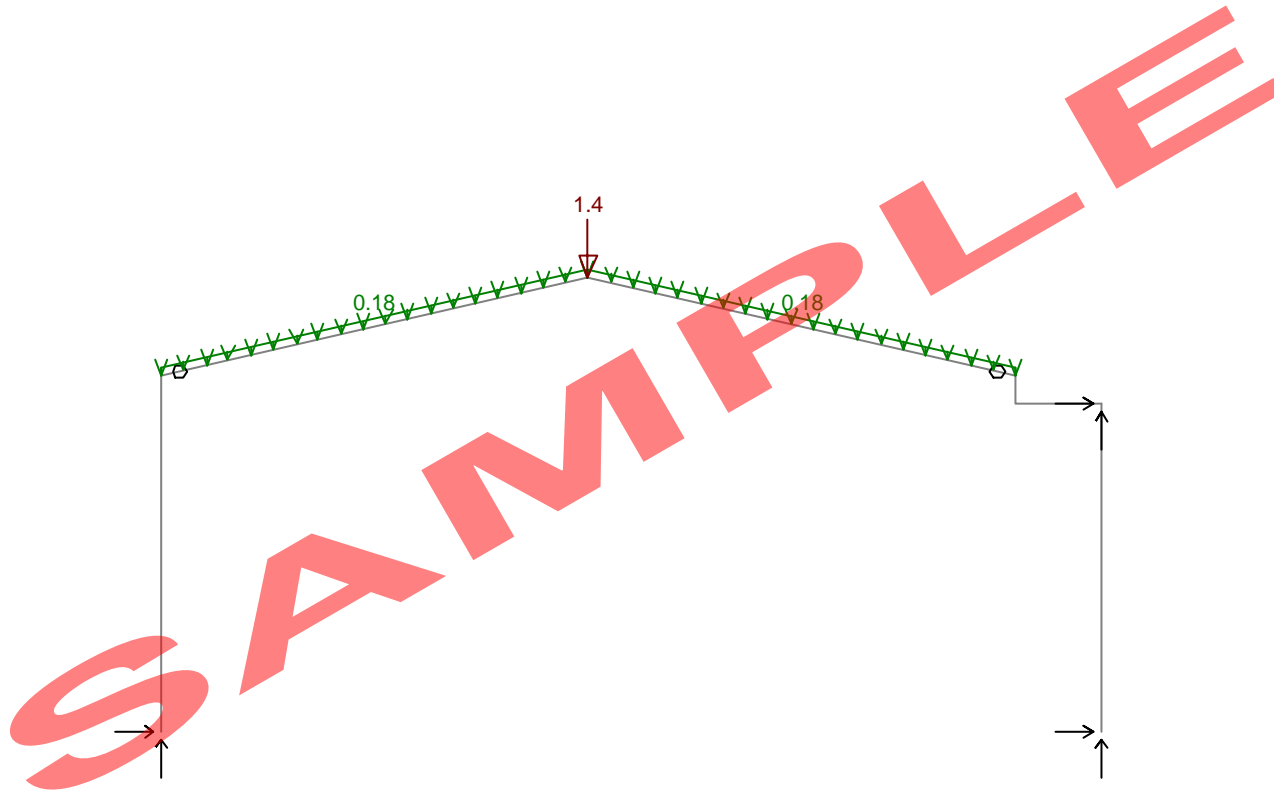
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Gravity Loading - Main Frame

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- Load Cases:
- 5 P Deadloads
 - 7 P PointLoad



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theta: 270 phi: 0

Gravity Loading - Main Frame

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Envelope for Axial Force

— Maximum

— Minimum

Enveloped Cases:

8 C WL1+0.8DL

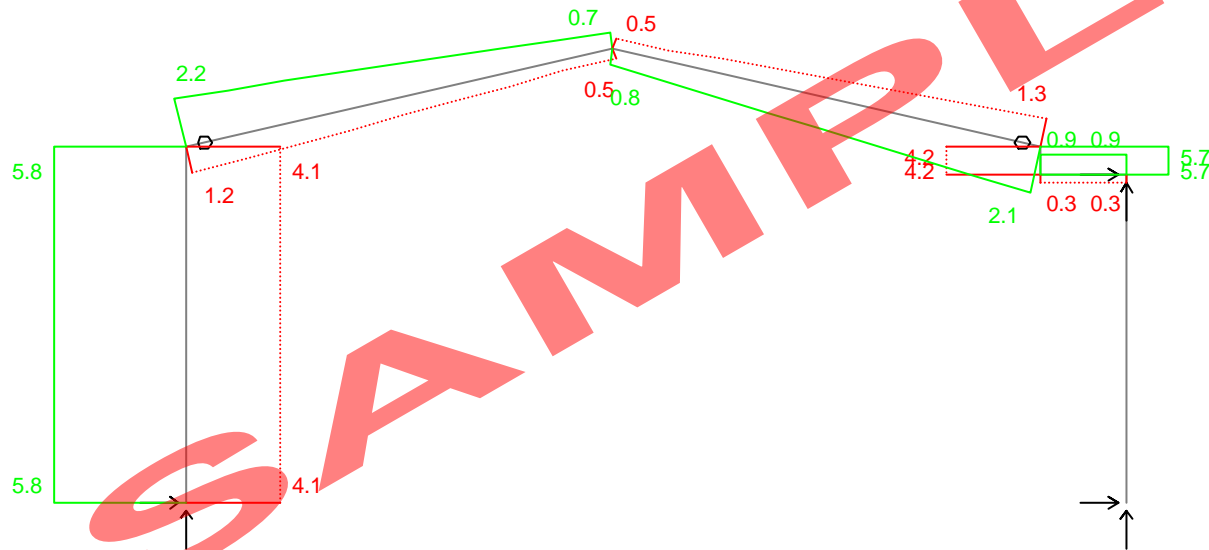
9 C WL2+0.8DL

10 C WL3+0.8DL

11 C WL4+0.8DL

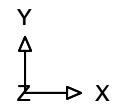
12 C 1.25DL+1.5LL

13 C 1.25DL+1.5PL



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theta: 270 phi: 0

Main Frame : Axial Envelope

Axial Force, Fx

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Envelope for Shear Fy

— Maximum

— Minimum

Enveloped Cases:

8 C WL1+0.8DL

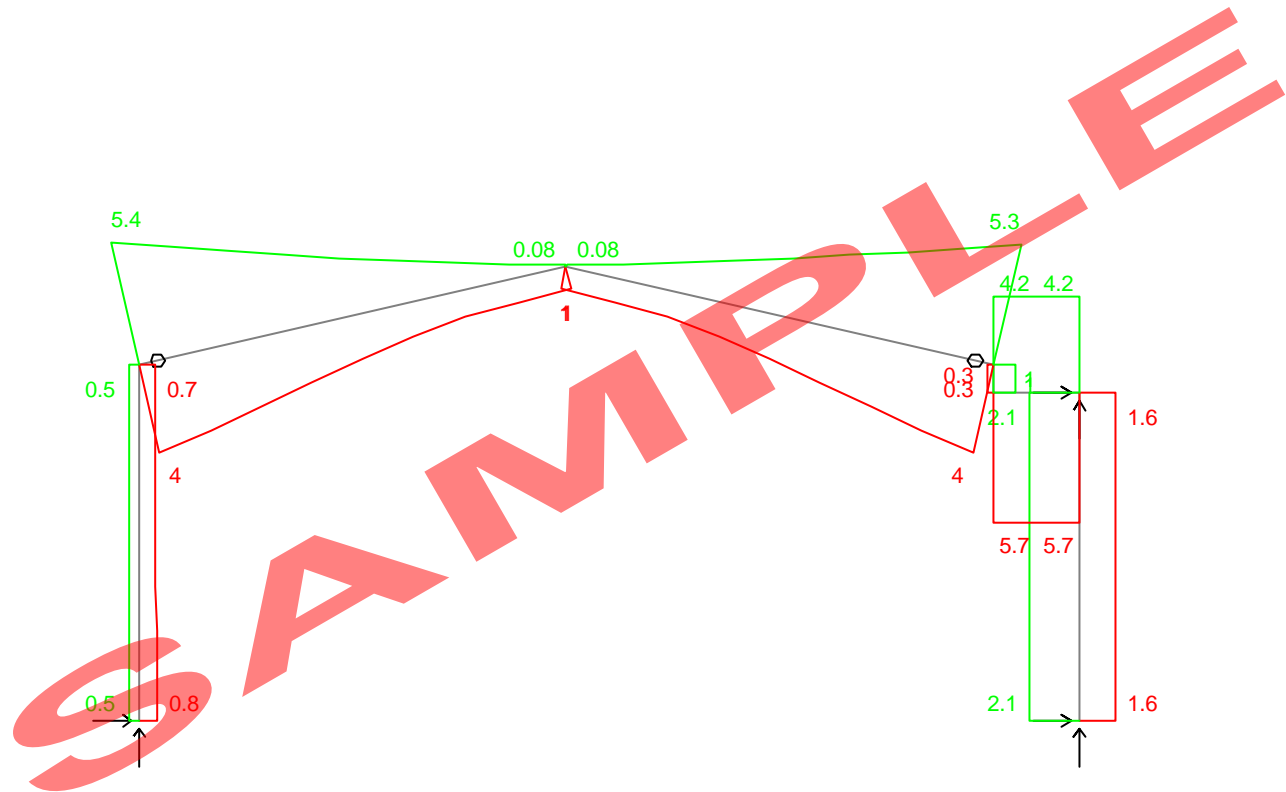
9 C WL2+0.8DL

10 C WL3+0.8DL

11 C WL4+0.8DL

12 C 1.25DL+1.5LL

13 C 1.25DL+1.5PL



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Y
↑
Z → X
theta: 270 phi: 0

Main Frame : Shear Envelope

Shear Force, Fy

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Envelope for Moment Mz

— Maximum

— Minimum

Enveloped Cases:

8 C WL1+0.8DL

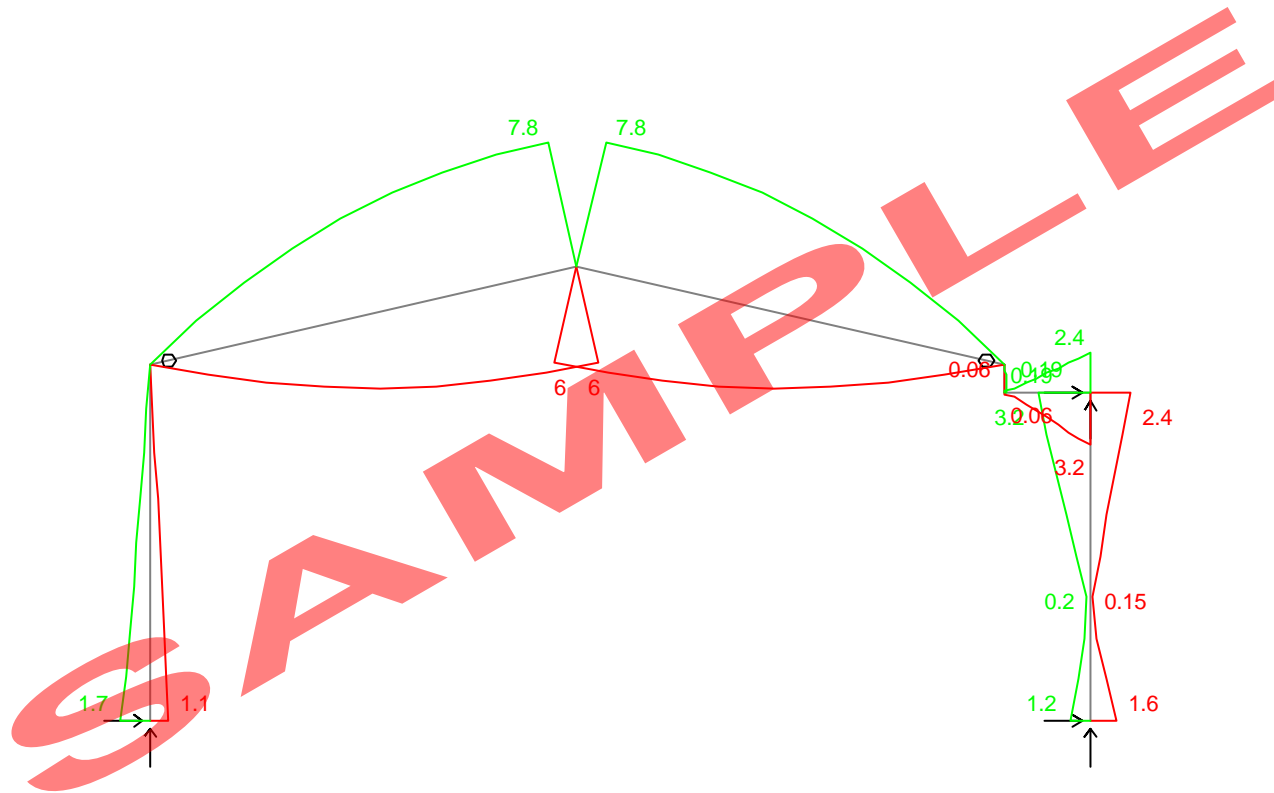
9 C WL2+0.8DL

10 C WL3+0.8DL

11 C WL4+0.8DL

12 C 1.25DL+1.5LL

13 C 1.25DL+1.5PL



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Main Frame : Moment Envelope

Bending Moment, Mz

Y
↑
Z → X
theta: 270 phi: 0

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LOAD CASES - STEEL DESIGN

Case	Type	Title
8	C	WL1+0.8DL
9	C	WL2+0.8DL
10	C	WL3+0.8DL
11	C	WL4+0.8DL
12	C	1.25DL+1.5LL
13	C	1.25DL+1.5PL

STEEL MEMBERS SUMMARY REPORT

Memb	Code	Length mm	Grade	Section Name	Crit. Ratio	Load Case	Critical Condition
1	AS4100	2500	C350	65X65X2.5SHS	2.539	8	Section N+Mx
5	AS4100	2300	C350	65X65X2.5SHS	1.383	8	Section bending
9	AS4100	200	C350	65X65X2.5SHS	15.412	9	Section N+Mx
<u>10</u>	<u>AS4100</u>	<u>600</u>	<u>C350</u>	<u>65X65X2.5SHS</u>	<u>1.382</u>	<u>8</u>	<u>Section N+Mx</u>

LOAD CASES - STEEL DESIGN

Case	Type	Title
<u>8</u>	<u>C</u>	<u>WL1+0.8DL</u>
9	C	WL2+0.8DL
10	C	WL3+0.8DL
11	C	WL4+0.8DL
12	C	1.25DL+1.5LL
13	C	1.25DL+1.5PL

STEEL MEMBERS FULL REPORT

MEMBER: 1 (Code Check to AS4100)

Section: 65X65X2.5SHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D=	65.0	B=	65.0	T=	2.5
Ag=	609.0	rx=	25.3	Zx=	1.20E+04
		ry=	25.3	Zy=	1.20E+04
		J=	6.24E+05	Iw=	0.00E+00
Sx=	1.41E+04	Sy=	1.41E+04		

Section Properties for Design:

Form Factor=	1.000	Class Mx:	Compact	Zex=	1.410E+04
Ae=	609	Class My:	Compact	Zey=	1.410E+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	2.500	L	L	N					

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

Critical conditions for design load cases:

Case	Cap/Load	Condition
8	2.539	Section N+Mx
9	2.637	Section N+Mx
10	3.425	Section N+Mx
11	3.425	Section N+Mx
12	3.345	Member out-plane C+Mx
13	6.223	Member out-plane C+Mx

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SECTION CHECKS

Case: 8 Off: 0 Cap/Load= 2.539 Section N+Mx (8.3.2)

Design loads:	N*=	5.46 t	M*x=	-1.75	M*y=	0.00
Design capacities	øNt=	191.83	øMsx=	4.44	øMsy=	4.44
	øNs=	0.00	øMrx=	4.44	øMry=	4.44

MEMBER/SEGMENT CHECKS

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Case: 8 Off: 0/2500 Cap/Load= 2.539 Section N+Mx (8.3.2)

Design loads: N*= 5.46 t M*x= -1.75 M*y= 0.00
 Lmx= 2500 column o/a length βmx= 1.000
 Lmy= 2500 βmy= 0.000
 Lx= 2500 βme= 0.000
 Ly= 2500 αm= 1.992 BM modification factor
 Le= 2500 beam eff. length αs= 1.00 BM slend. reductn. factor
 Lz= 2500 torsion eff. length Transversely loaded.

Design capacities
 øNt= 191.83 øMsx= 4.44 øMbx= 4.44 øMox= 4.44
 øMrx= 4.44 øMix= 0.00 øMbxo= 0.00
 øMsy= 4.44 øMiy= 0.00 øNoz= 0.00
 øMry= 4.44 øMcy= 0.00

SHEAR CHECKS (Appendix I excluded)

Case: 8 Off: 0 Cap/Load= 70.892 Section N+Mx (8.3.2)

Design loads: V*= 0.80

Design capacities øVv= 56.70 øMf= 3.20

MEMBER: 5 (Code Check to AS4100)

Section: 65X65X2.5SHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D= 65.0 B= 65.0 T= 2.5
 Ag= 609.0 rx= 25.3 Zx= 1.20E+04 Sx= 1.41E+04
 ry= 25.3 Zy= 1.20E+04 Sy= 1.41E+04
 J= 6.24E+05 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 1.000 Class Mx: Compact Zex= 1.410E+04
 Ae= 609 Class My: Compact Zey= 1.410E+04

Member Restraints

No	Offset	Top	Btm	Cant	Load	XX	kx	YY	ky
1	0.000	L	L	N	S	Y	1.00	Y	1.00
2	2.300	L	L	N					

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

Critical conditions for design load cases:

Case	Cap/Load	Condition
8	1.383	Section bending
9	1.447	Section bending
10	1.802	Section bending
11	1.802	Section bending
12	1.819	Section bending
13	4.428	Section bending

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SECTION CHECKS

Case: 8 Off: 2300 Cap/Load= 1.383 Section bending (5.2)

Design loads: N*= 0.00 M*x= -3.21 M*y= 0.00
 Design capacities øNt= 0.00 øMsx= 4.44 øMsy= 4.44
 øNs= 0.00 øMrx= 0.00 øMry= 0.00

MEMBER/SEGMENT CHECKS

Case: 8 Off: 0/2300 Cap/Load= 1.383 Member bending (5.6)

Design loads: N*= 0.00 M*x= -3.21 M*y= 0.00
 Lmx= 2300 column o/a length βmx= 0.500
 Lmy= 2300 βmy= 0.000
 Lx= 2300 βme= 0.500
 Ly= 2300 αm= 2.483 BM modification factor

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Le= 2300 beam eff. length αs= 1.01 BM slend. reductn. factor
 Lz= 2300 torsion eff. length

Design capacities

∅Ncx= 0.00 ∅Msx= 4.44 ∅Ncy= 0.00 # ∅Mox= 0.00
 ∅Ncy= 0.00 ∅Mrx= 0.00 ∅Ncx= 0.00 # ∅Mbxo= 0.00
 ∅Msy= 4.44 ∅Mix= 0.00 ∅Noz= 0.00
 ∅Mry= 0.00 ∅Miy= 0.00 ∅Mcy= 0.00
 ∅Mbx= 4.44 # computed with kL ≤ Lm (8.4.2.2)

SHEAR CHECKS (Appendix I excluded)

Case: 8 Off: 0 Cap/Load= 27.062 Section bending (5.2)

Design loads: V*= 2.10

Design capacities

∅Vv= 56.70 ∅Mf= 3.20

MEMBER: 9 (Code Check to AS4100)

Section: 65X65X2.5SHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D= 65.0 B= 65.0 T= 2.5
 Ag= 609.0 rx= 25.3 Zx= 1.20E+04 Sx= 1.41E+04
 ry= 25.3 Zy= 1.20E+04 Sy= 1.41E+04
 J= 6.24E+05 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 1.000 Class Mx: Compact Zex= 1.410E+04
 Ae= 609 Class My: Compact Zey= 1.410E+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	0.200	L	L	N					

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

Critical conditions for design load cases:

Case	Cap/Load	Condition
8	15.720	Section N+Mx
9	15.412	Section N+Mx
10	20.342	Section N+Mx
11	20.342	Section N+Mx
12	30.551	Section N+Mx
13	57.000	Section N+Mx

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SECTION CHECKS

Case: 9 Off: 200 Cap/Load= 15.412 Section N+Mx (8.3.2)

Design loads: N*= 5.43 t M*x= -0.19 M*y= 0.00
 Design capacities ∅Nt= 191.83 ∅Msx= 4.44 ∅Msy= 4.44
 ∅Ns= 0.00 ∅Mrx= 4.44 ∅Mry= 4.44

MEMBER: 10 (Code Check to AS4100)

Section: 65X65X2.5SHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D= 65.0 B= 65.0 T= 2.5
 Ag= 609.0 rx= 25.3 Zx= 1.20E+04 Sx= 1.41E+04
 ry= 25.3 Zy= 1.20E+04 Sy= 1.41E+04
 J= 6.24E+05 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 1.000 Class Mx: Compact Zex= 1.410E+04
 Ae= 609 Class My: Compact Zey= 1.410E+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	0.200	L	L	N					

SCH

No	Offset	Top	Btm	Cant	Ht	XX	kx	YY	ky
1	0.000	L	L	N	S	Y	1.00	Y	1.00
2	0.600	L	L	N					

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

Critical conditions for design load cases:

Case	Cap/Load	Condition
8	1.382	Section N+Mx
9	1.447	Section N+Mx
10	1.802	Section N+Mx
11	1.802	Section N+Mx
12	1.815	Member out-plane C+Mx
13	4.408	Member out-plane C+Mx

SECTION CHECKS

Case: 8 Off: 600 Cap/Load= 1.382 Section N+Mx (8.3.2)

Design loads:	N*= 0.87 t	M*x= 3.21	M*y= 0.00
Design capacities	$\phi N_t = 191.83$	$\phi M_{sx} = 4.44$	$\phi M_{sy} = 4.44$
	$\phi N_s = 0.00$	$\phi M_{rx} = 4.44$	$\phi M_{ry} = 4.44$

MEMBER/SEGMENT CHECKS

Case: 8 Off: 0/600 Cap/Load= 1.384 Section N+Mx (8.3.2)

Design loads:	N*= 0.87 t	M*x= 3.21	M*y= 0.00
Lmx= 600 column o/a length	$\beta_{mx} = 0.056$		
Lmy= 600	$\beta_{my} = 0.000$		
Lx= 600	$\beta_{me} = 0.056$		
Ly= 600	$\alpha_m = 1.891$ BM modification factor		
Le= 600 beam eff. length	$\alpha_s = 1.03$ BM slend. reductn. factor		
Lz= 600 torsion eff. length			

Design capacities	$\phi N_t = 191.83$	$\phi M_{sx} = 4.44$	$\phi M_{bx} = 4.44$	$\phi M_{ox} = 4.44$
		$\phi M_{rx} = 4.44$	$\phi M_{ix} = 0.00$	$\phi M_{bxo} = 0.00$
		$\phi M_{sy} = 4.44$	$\phi M_{iy} = 0.00$	$\phi N_{oz} = 0.00$
		$\phi M_{ry} = 4.44$		$\phi M_{cx} = 0.00$

SHEAR CHECKS (Appendix I excluded)

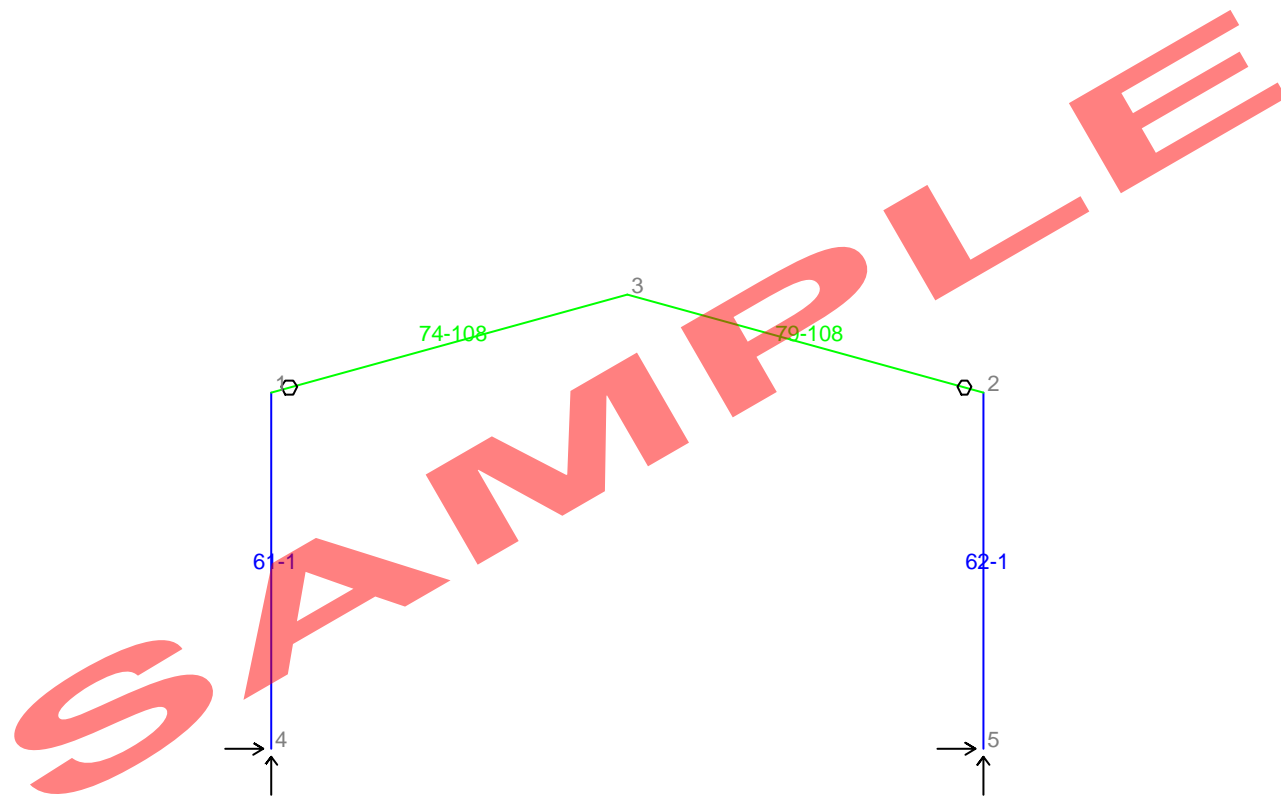
Case: 8 Off: 0 Cap/Load= 10.030 Shear yield (5.11.4)

Design loads:	V*= 5.65	
Design capacities	$\phi V_v = 56.70$	$\phi M_f = 3.20$

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Sections:
— 1 65X65X2.5SHS Y
— 108 C15019



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Y
↑
Z → X
theta: 270 phi: 0

Branched Canopy Frame - Design Geometry

REF.:	985	PAGE:	
DESIGN:	SCH	DATE:	15-Oct-2001

TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

FRAME LOADING

DEAD

Sheeting	0.04 kPa = kN/m ²		
Purlins/Girts	0.02 kPa = kN/m ²		
	<u>$\sum DL$ 0.06 kPa</u> x 2.667 =		0.16 kN/m
Swt Frame			0.04 kN/m
		<u>$\sum DL$</u>	0.20 kN/m

LIVE (Roof)

Projected Area of Portal Rafter A	=	2.67 x 6.00	
	=	16 m ²	
LL	=	(1.8/A + 0.12)	= 0.23 kPa
$\sum LL$	=	0.25 kPa x 2.667	= <u>0.67 kN/m</u>

OCCASSIONAL POINT LOAD (OPL)

Industrial	<u>$\sum OPI$ =</u>	<u>1.4 kN</u>	Domestic
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SAMPLE

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--

TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Doubly Pitched Canopy **Canopy Branch**

Alpha	15.0 degrees =	0.26 radians =	Pitch 1 in	3.73
Building Eaves Hght	2.500 m	Building Span		6.000 m
Bay Spacing	2.667 m	Number of Bays		3
Building Length	8.000 m	Number of Columns		8

Region A	Vp =	41 m/s	Vs =	38 m/s
Location : Adelaide	Vu =	50 m/s	sensitivity	{static analysis acceptable}
b/d =	1.33	d/b =	0.75	h/d = 0.42

Q = 0
Wind Classification to AS1170
a < 60 h = he = 2.500 m

Tcat 3 TC3.0
M[z,cat] = 0.75
M[s] = 0.85 FS
M[t] = 1 T1
M[i] = 1
directional M[d] = 0.95

Vz =	Perm	Limit	
	30.0	30.3 m/s	
qz =	0.54	0.55 kPa	

Q = 90
Wind Classification to AS1170
h = ht = 3.304 m

Tcat 3 TC3.0
M[z,cat] = 0.75
M[s] = 0.85 FS
M[t] = 1 T1
M[i] = 1
M[d] = 0.95

Vz =	Perm	Limit	
	30.0	30.3 m/s	
qz =	0.54	0.55 kPa	

Wind Classification to AS4055
N1 WP28,WU34
Vz = 28 34 m/s
qz = 0.47 0.69 kPa

Wind Classification to AS4055
N1 WP28,WU34
Vz = 28 34 m/s
qz = 0.47 0.69 kPa

Design	AS1170	Limit State
Vz =	30.3 m/s	
qz =	0.55 kPa	
wz =	1.47 kN/m	

Design	AS1170	Limit State
Vz =	30.3 m/s	
qz =	0.55 kPa	
wz =	1.47 kN/m	

b =	6.00 m	d =	8.00 m
local pressure extent = 'a' =	min	$\begin{matrix} 0.2 b \\ 0.2 d \\ ht \end{matrix}$	= 1.2 m
a/2 =	0.6 m		
Length along Slope of Rafter =			3.106 m

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Area Reduction Factors

Tributary Area

			m ²	Ka
Rafter				
Aligned	6.212 x 2.667	=	16.57	0.96
Projected	6.000 x 2.667	=	16.00	0.96
Column				
Aligned	2.500 x 2.667	=	6.67	1.00

TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Doubly Pitched Canopy Canopy Branch

Q = 0 Transverse



a < 60 h = he = 2.500 m
length b = 8.000 m
span d = 6.000 m
h/d = 0.42
d/h = 2.40
d/b = 0.75

State : Blocked Under

a =15.0	Cpw	Cpl
-ve	-1.2	-1.3
+ve		

Frictional Drag on Roof

F1 = 0.01 bd qz
√ F1 = smooth/parallel to ribs 0.26 kN
2F1 = across corrugations 0.53 kN
4F1 = across ribs 1.06 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 m ²	Fd kN
Column	20.0	0.90	0.31
Rafter			0.20
			Σ 0.20

Q = 90 Longitudinal



h = ht = 3.304 m
span b = 6.000 m
length d = 8.000 m
h/d = 0.41
d/h = 2.42
d/b = 1.33

State : Blocked Under

a =15.0	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 0.26 kN
2F1 = across corrugations 0.53 kN
4F1 = across ribs 1.06 kN

Drag on Frame

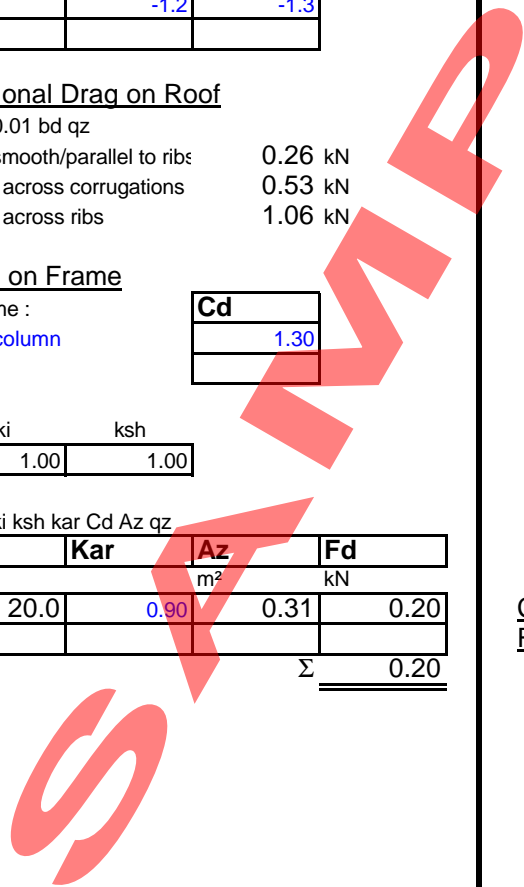
Assume :
125.00 SHS column
125.00 Channel Rafter

Cd
1.30
1.90

ki	ksh
1.00	1.00

Fd = ki ksh kar Cd Az qz

l/b	Kar	Az m ²	Fd kN
Column	20.0	0.90	0.31
Rafter	24.8	1.00	0.39
			Σ 0.61



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Wind on Gable End (if present)

Cpw = 0.7
Cpl = -0.5
Cpn = 1.2

Full Rise of Roof = 0.804 m
Area of Gable = 2.413 m²

Uplift

= bd Cpn qz
Total = 34.3 kN
5.7 kN/column

Uplift

= bd Cpn qz
Total = 26.4 kN
4.4 kN/column

REF.:	985	PAGE:	
DESIGN:	SCH	DATE:	15-Oct-2001

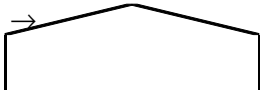
TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Doubly Pitched Canopy Canopy Branch

Q = 0

Transverse



Loads on Single Frame supporting 1 bay

Drag Load Roof {1 bay}	0.09 kN @top col.
Drag on Windward Column	0.08 kN/m
Winward Roof	-1.69 kN/m
Leeward Roof	-1.83 kN/m
Drag on Leeward Column	0.08 kN/m

Q = 90

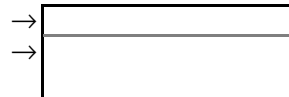
Longitudinal



Loads on Single Frame supporting 1 bay

Winward Roof	-1.41 kN/m
--------------	------------

Loads on Longitudinal Frame



Drag Load Roof {1 side}	0.53 kN
Drag on rafter	0.41 kN/rafter
Drag on Column	0.20 kN/column

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Envelope for Axial Force

— Maximum

— Minimum

Enveloped Cases:

8 C WL1+0.8DL

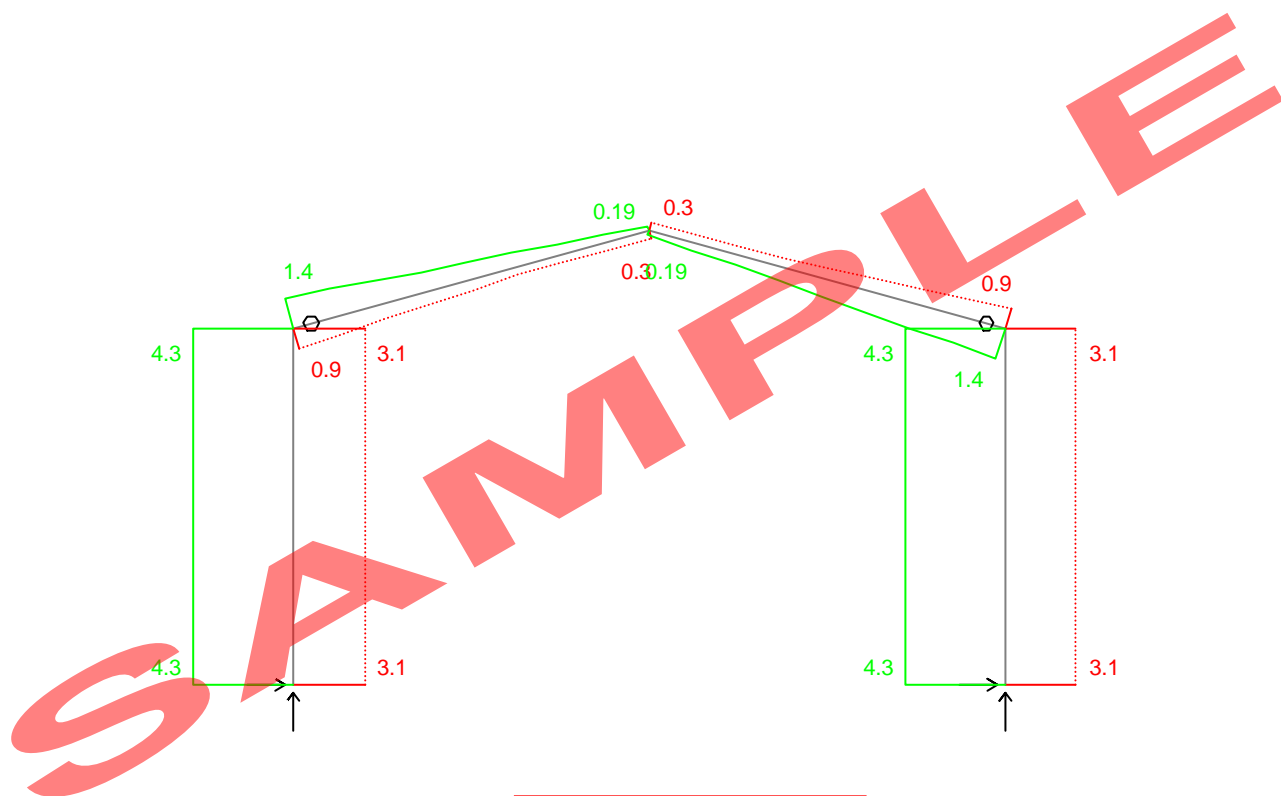
9 C WL2+0.8DL

10 C WL3+0.8DL

11 C WL4+0.8DL

12 C 1.25DL+1.5LL

13 C 1.25DL+1.5PL



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Y
↑
Z → X
theta: 270 phi: 0

Branched Canopy Frame - Axial Envelope

Axial Force, Fx

Envelope for Shear Fy

— Maximum

— Minimum

Enveloped Cases:

8 C WL1+0.8DL

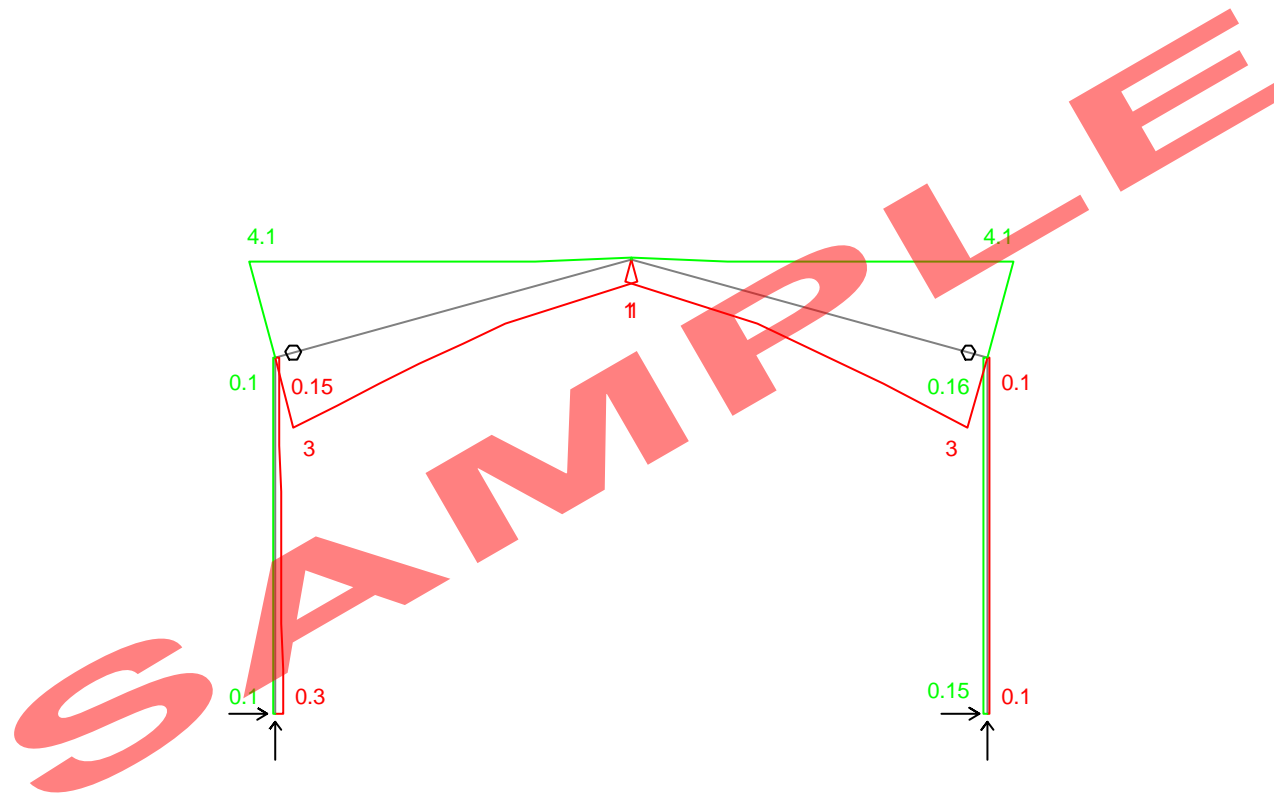
9 C WL2+0.8DL

10 C WL3+0.8DL

11 C WL4+0.8DL

12 C 1.25DL+1.5LL

13 C 1.25DL+1.5PL



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Y
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Z → X
theta: 270 phi: 0

Branched Canopy Frame - Shear Envelope

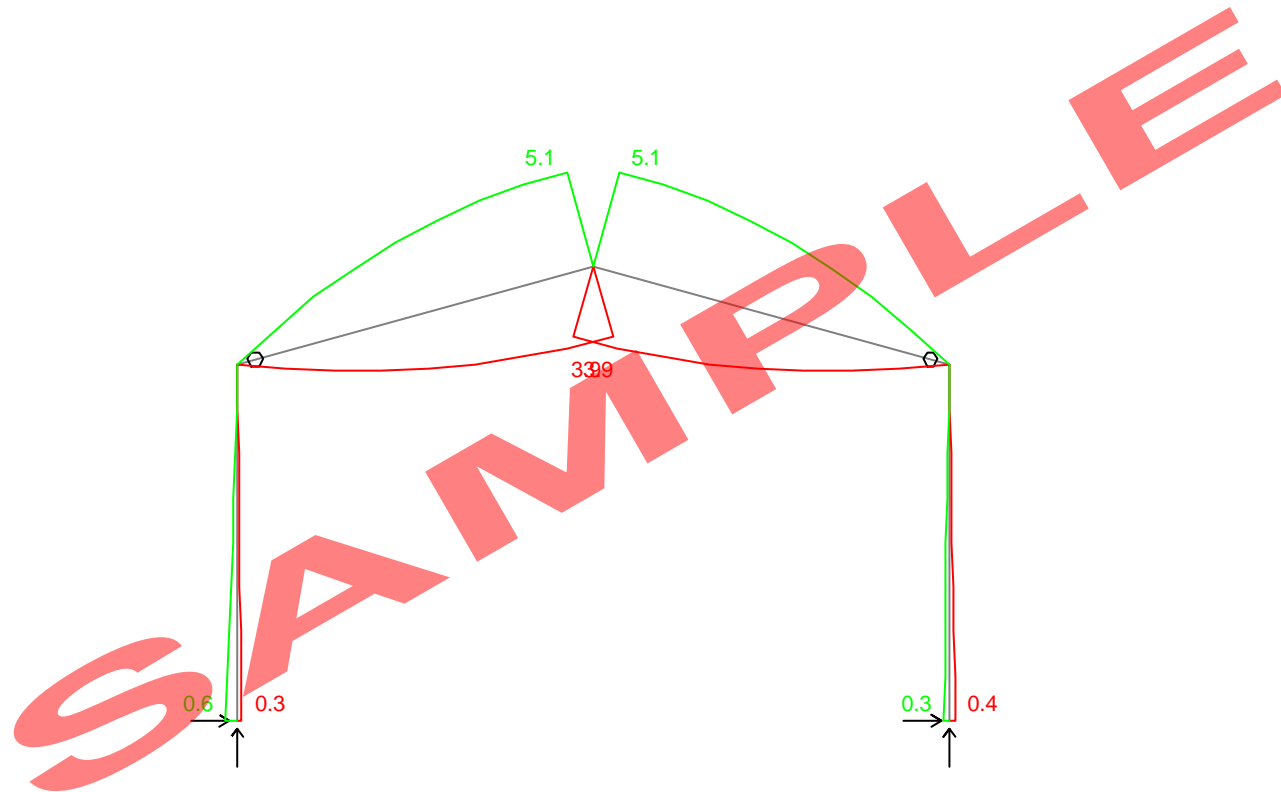
Shear Force, Fy

Envelope for Moment Mz

- Maximum
- Minimum

Enveloped Cases:

- 8 C WL1+0.8DL
- 9 C WL2+0.8DL
- 10 C WL3+0.8DL
- 11 C WL4+0.8DL
- 12 C 1.25DL+1.5LL
- 13 C 1.25DL+1.5PL



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Y
↑
Z → X
theta: 270 phi: 0

Branched Canopy Frame - Moment Envelope

Bending Moment, Mz

LOAD CASES - STEEL DESIGN

Case	Type	Title
8	C	WL1+0.8DL
9	C	WL2+0.8DL
10	C	WL3+0.8DL
11	C	WL4+0.8DL
12	C	1.25DL+1.5LL
13	C	1.25DL+1.5PL

STEEL MEMBERS SUMMARY REPORT

Memb	Code	Length mm	Grade Name	Section	Crit. Ratio	Load Critical Case Condition
61	AS4100	2500	C350	65X65X2.5SHS	7.254	8 Section N+Mx
62	AS4100	2500	C350	65X65X2.5SHS	10.682	9 Section N+Mx

LOAD CASES - STEEL DESIGN

Case	Type	Title
8	C	WL1+0.8DL
9	C	WL2+0.8DL
10	C	WL3+0.8DL
11	C	WL4+0.8DL
12	C	1.25DL+1.5LL
13	C	1.25DL+1.5PL

STEEL MEMBERS FULL REPORT

MEMBER: 61 (Code Check to AS4100)

Section: 65X65X2.5SHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D=	65.0	B=	65.0	T=	2.5
Ag=	609.0	rx=	25.3	Zx=	1.20E+04
		ry=	25.3	Zy=	1.20E+04
		J=	6.24E+05	Iw=	0.00E+00
Sx=	1.41E+04	Sy=	1.41E+04		

Section Properties for Design:

Form Factor=	1.000	Class Mx:	Compact	Zex=	1.410E+04
Ae=	609	Class My:	Compact	Zey=	1.410E+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	2.500	L	L	N					

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

Critical conditions for design load cases:

Case	Cap/Load	Condition
8	7.254	Section N+Mx
9	10.608	Section N+Mx
10	13.635	Section N+Mx
11	13.635	Section N+Mx
12	10.854	Member out-plane C+Mx
13	17.086	Member out-plane C+Mx

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SECTION CHECKS

Case: 8 Off: 0 Cap/Load= 7.254 Section N+Mx (8.3.2)

Design loads:	N*=	4.14 t	M*x=	-0.61	M*y=	0.00
Design capacities	øNt=	191.83	øMsx=	4.44	øMsy=	4.44
	øNs=	0.00	øMrx=	4.44	øMry=	4.44

MEMBER/SEGMENT CHECKS

Case: 8 Off: 0/2500 Cap/Load= 7.255 Section N+Mx (8.3.2)

Design loads:	N*=	4.14 t	M*x=	-0.61	M*y=	0.00
---------------	-----	--------	------	-------	------	------

Lmx= 2500 column o/a length βmx= 1.000
 Lmy= 2500 βmy= 0.000
 Lx= 2500 βme= 0.000
 Ly= 2500 αm= 2.187 BM modification factor
 Le= 2500 beam eff. length αs= 1.00 BM slend. reductn. factor
 Lz= 2500 torsion eff. length Transversely loaded.

Design capacities

øNt= 191.83 øMsx= 4.44 øMbx= 4.44 øMox= 4.44
 øMrx= 4.44 øMix= 0.00 øMbxo= 0.00
 øMsy= 4.44 øMiy= 0.00 øNoz= 0.00
 øMry= 4.44 øMcy= 0.00

SHEAR CHECKS (Appendix I excluded)

Case: 8 Off: 0 Cap/Load= > 100 Section N+Mx (8.3.2)

Design loads: V*= 0.34

Design capacities

 øVv= 56.70 øMf= 3.20

MEMBER: 62 (Code Check to AS4100)

Section: 65X65X2.5SHS Axis: Y Grade: C350 fy: 350 fu: 430

Section dimensions and properties.

D= 65.0 B= 65.0 T= 2.5
 Ag= 609.0 rx= 25.3 Zx= 1.20E+04 Sx= 1.41E+04
 ry= 25.3 Zy= 1.20E+04 Sy= 1.41E+04
 J= 6.24E+05 Iw= 0.00E+00

Section Properties for Design:

Form Factor= 1.000 Class Mx: Compact Zex= 1.410E+04
 Ae= 609 Class My: Compact Zey= 1.410E+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	2.500	L	L	N					

Sideway - about XX axis: N about YY axis: N

Critical conditions for design load cases:

Case	Cap/Load	Condition
8	19.486	Section N+Mx
9	10.682	Section N+Mx
10	13.635	Section N+Mx
11	13.635	Section N+Mx
12	10.854	Member out-plane C+Mx
13	17.086	Member out-plane C+Mx

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SECTION CHECKS

Case: 9 Off: 0 Cap/Load= 10.682 Section N+Mx (8.3.2)

Design loads: N*= 4.14 t M*x= 0.38 M*y= 0.00

Design capacities øNt= 191.83 øMsx= 4.44 øMsy= 4.44
 øNs= 0.00 øMrx= 4.44 øMry= 4.44

MEMBER/SEGMENT CHECKS

Case: 9 Off: 0/2500 Cap/Load= 10.683 Section N+Mx (8.3.2)

Design loads: N*= 4.14 t M*x= 0.38 M*y= 0.00

Lmx= 2500 column o/a length βmx= 0.000
 Lmy= 2500 βmy= 0.000
 Lx= 2500 βme= 0.000
 Ly= 2500 αm= 1.874 BM modification factor
 Le= 2500 beam eff. length αs= 1.00 BM slend. reductn. factor
 Lz= 2500 torsion eff. length

Design capacities

øNt= 191.83	øMsx= 4.44	øMbx= 4.44	øMox= 4.44
	øMrx= 4.44	øMix= 0.00	øMbxo= 0.00
	øMsy= 4.44	øMiy= 0.00	øNoz= 0.00
	øMry= 4.44		øMcx= 0.00

SHEAR CHECKS (Appendix I excluded)

Case: 8 Off: 0 Cap/Load= > 100 Section N+Mx (8.3.2)

Design loads: V*= 0.04

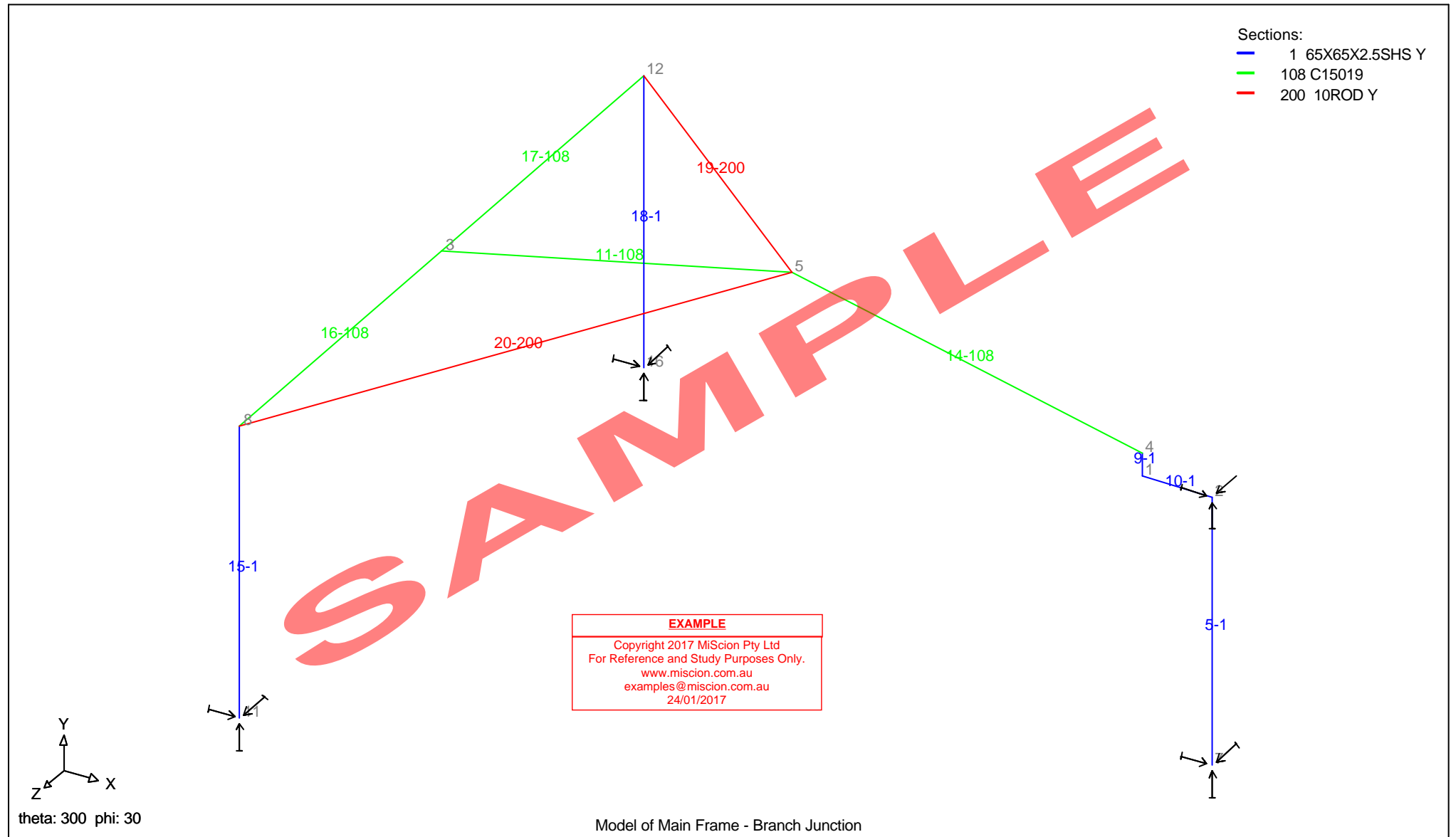
Design capacities

øVv= 56.70 øMf= 3.20

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Envelope for Moment Mz

— Maximum

— Minimum

Enveloped Cases:

8 C WL1+0.8DL

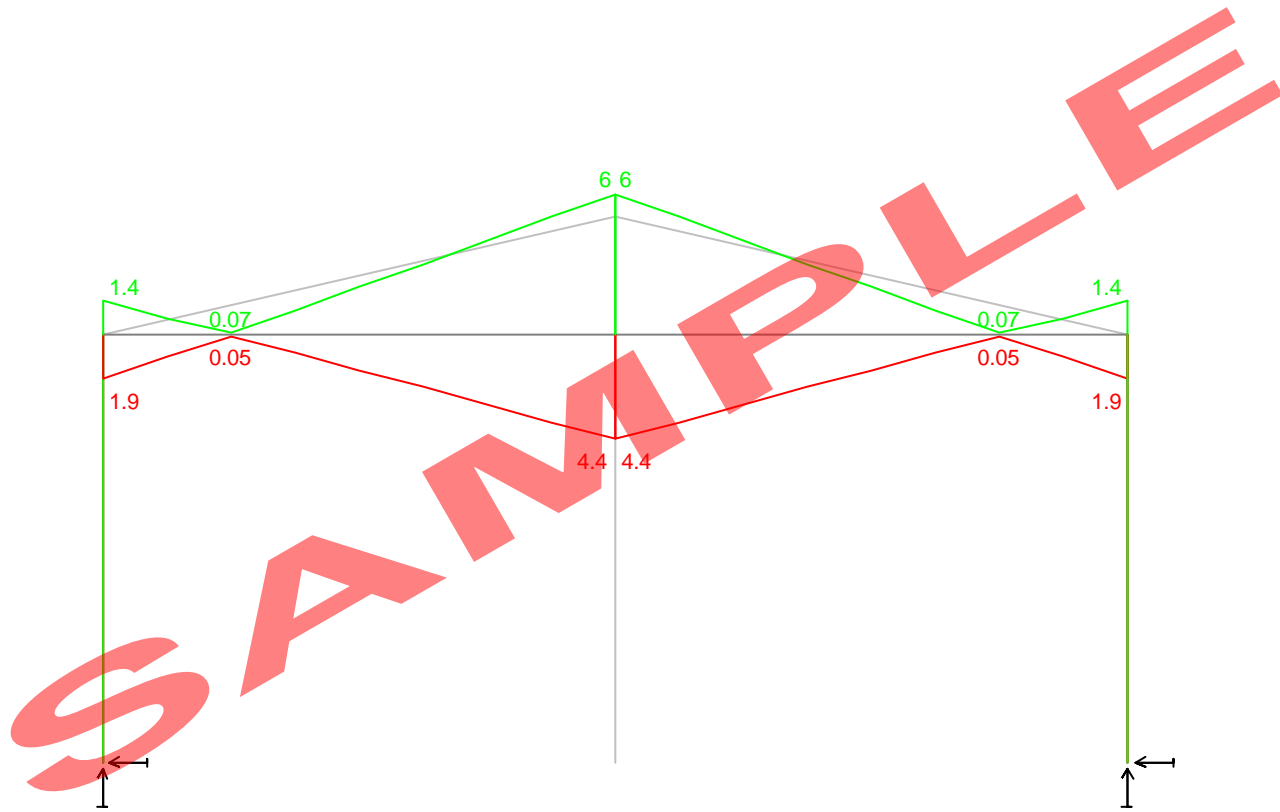
9 C WL2+0.8DL

10 C WL3+0.8DL

11 C WL4+0.8DL

12 C 1.25DL+1.5LL

13 C 1.25DL+1.5PL



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Y
↑
Z ← X
theta: 0 phi: 0

Main Frame - Branch Junction - Moment Envelope

Bending Moment, Mz

Envelope for Moment Mz

— Maximum

— Minimum

Enveloped Cases:

8 C WL1+0.8DL

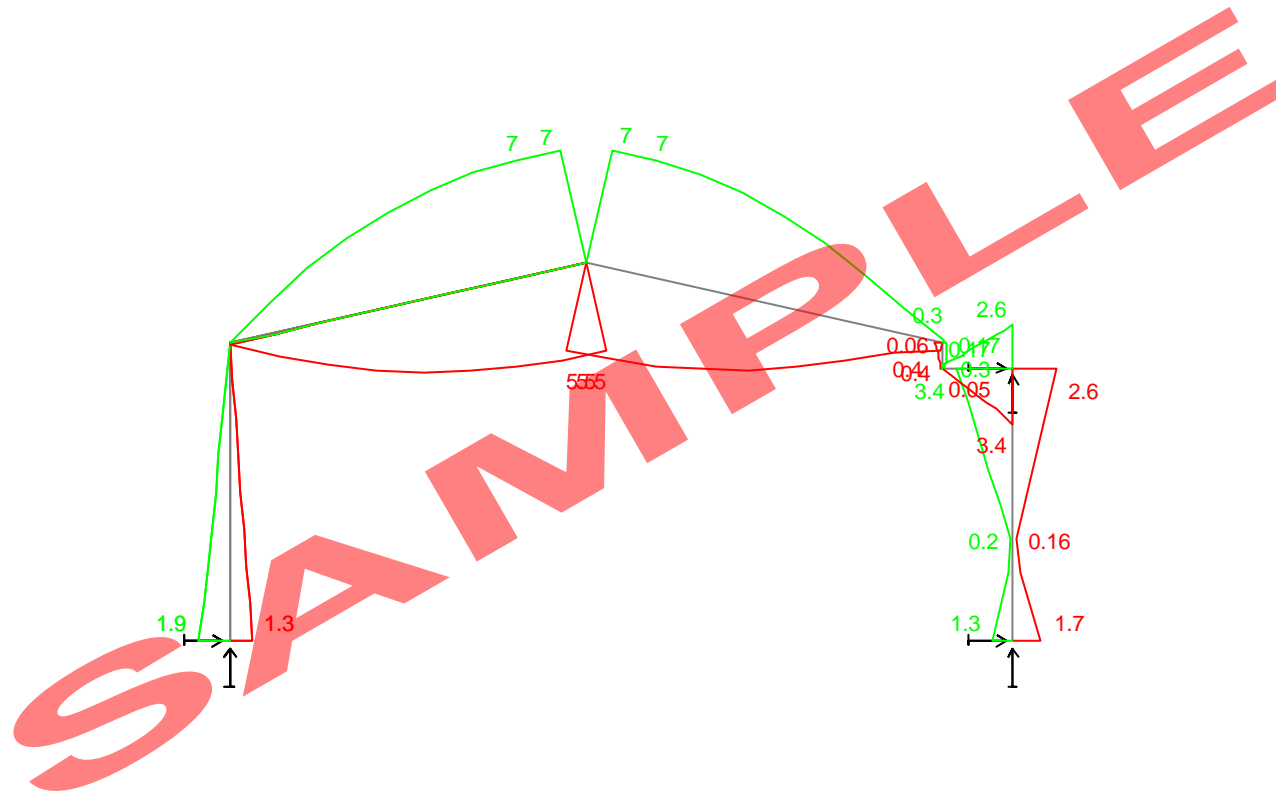
9 C WL2+0.8DL

10 C WL3+0.8DL

11 C WL4+0.8DL

12 C 1.25DL+1.5LL

13 C 1.25DL+1.5PL



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Y
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Z → X
theta: 270 phi: 0

Main Frame - Branch Junction - Moment Envelope

Bending Moment, Mz

LOAD CASES - STEEL DESIGN

Case	Type	Title
8	C	WL1+0.8DL
9	C	WL2+0.8DL
10	C	WL3+0.8DL
11	C	WL4+0.8DL
12	C	1.25DL+1.5LL
13	C	1.25DL+1.5PL

STEEL MEMBERS SUMMARY REPORT

Memb	Code	Length mm	Grade	Section Name	Crit. Ratio	Load Case	Critical Condition
5	AS4100	2300	C350	<u>65X65X2.5SHS</u>	<u>1.301</u>	8	Section bending
9	AS4100	200	C350	<u>65X65X2.5SHS</u>	9.199	9	Section N+Mx
10	AS4100	600	C350	<u>65X65X2.5SHS</u>	<u>1.301</u>	8	Section N+Mx
15	AS4100	2500	C350	<u>65X65X2.5SHS</u>	1.432	9	Member T+Mx+My
18	AS4100	2500	C350	<u>65X65X2.5SHS</u>	1.432	9	Member T+Mx+My

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TITLE :

: Verandah, 6m Wide x 2.5m Eaves, 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	1.20	0.6	1.50
dist ²	9.00	1.44	0.36	

a	b {'a'}	x1	L-x1
0.90	1.2	1.50	1.50
0.81	1.44		

	kN/m	kN
w1 full	-1.30	-3.90
w2 partial	-1.30	-0.78
Σ =	-2.60	-4.68

	kN/m	kN
	-1.30	-3.90
	-0.65	-0.78
Σ =	-1.95	-4.68

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 ↑↑↑	-0.53	-0.39	-0.39
Σ =	-1.99	-2.34	-2.34
Equiv UDL :	Cp_n	-1.77	

Moment	End Reactions	
	M[max]	Ra
	kNm	kN
	-1.46	-1.95
	-0.47	-0.39
	-1.93	-2.34
	-1.72	

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 ↑↑↑	-0.19	-0.70	-0.08
Σ =	-1.65	-2.65	-2.03
Equiv UDL :	Cp_n =	-1.47	

Moment	End Reactions	
	M[max]	Ra
	kNm	kN
	-1.46	-1.95
	-0.30	-0.62
	-1.76	-2.57
	-1.57	

MAX Equiv UDL :	Cp_n =	-1.77
------------------------	---------------	--------------

-1.72

'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	-0.60
Σ =	-2.00	-3.60

	kN/m	kN
	-1.00	-3
	-0.5	-0.6
Σ =	-1.50	-3.60

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 ↑↑↑	-0.15	-0.54	-0.06
Σ =	-1.27	-2.04	-1.56
Equiv UDL :	Cp_n =	-1.13	

Moment	End Reactions	
	M[max]	Ra
	kNm	kN
	-1.13	-1.50
	-0.23	-0.48
	-1.36	-1.98
	-1.20	

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TITLE :

: Verandah, 6m Wide x 2.5m Eaves, TC3

span = 3000 Int = 1000 c/c
Edge = 1000 c/c

PURLINS

{.. Limit State ..}

Wind Pressures

dwe = distance from windward edge a = local pressure extent

END WIND

qz = 0.55[kPa] {theta = 90}

		<u>Cpn</u>		<u>qz</u>			
{ dwe	≤	0.600 m = a/2 }	-1.13	x	0.55[kPa]	=	-0.62[kPa] ↑
{ dwe	≤	1.200 m = a }	-1.20	x	0.55[kPa]	=	-0.66[kPa] ↑
{ dwe	>	1.200 m = a }	-1.00	x	0.55[kPa]	=	-0.55[kPa] ↑

SIDE WIND

qz = 0.55[kPa] {theta = 0}

		<u>Cpn</u>		<u>qz</u>			
{ dwe	≤	0.600 m = a/2 }	-1.77	x	0.55[kPa]	=	-0.97[kPa] ↑
{ dwe	≤	1.200 m = a }	-1.72	x	0.55[kPa]	=	-0.94[kPa] ↑
{ dwe	>	1.200 m = a }	-1.30	x	0.55[kPa]	=	-0.72[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	1.000	3.00	-0.72	-0.04	-0.06	-1.20	-1.35
Outwards	1.000	0.72		-0.04	-0.06	0.64	0.72
Inwards	1.000	3.00	-0.72	-0.04	-0.06	-1.20	-1.35
Outwards	1.000	0.94		-0.04	-0.06	0.87	0.98
Inwards	1.000	3.00	-0.72	-0.04	-0.06	-1.20	-1.35
Outwards	1.000	0.97		-0.04	-0.06	0.90	1.01

ADOPT : **PURLINS** {for main canopy}

Stramit C7510 2-Span 1-Bridge per Span

Spacing

- @ 1000 c/c {for distance < 600 from edges}
- @ 1000 c/c {for 600 < distance from edges < 1200}
- @ 1000 c/c {for distance > 1200 from edges}

@3000mm Span w(IN) = 1.24 kN/m ↓
w(OUT) = 1.24 kN/m ↑

from Stramit Limit State Capacity Tables

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TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

span = 2667 Int = 1000 c/c
Edge = 1000 c/c

PURLINS

{.. Limit State ..}

Wind Pressures

dwe = distance from windward edge a = local pressure extent

END WIND

qz = 0.55[kPa] {theta = 90}

	dwe	Cpn	qz		
{ dwe ≤	0.600 m = a/2 }	-1.16	x 0.55[kPa]	=	-0.64[kPa] ↑
{ dwe ≤	1.200 m = a }	-1.24	x 0.55[kPa]	=	-0.68[kPa] ↑
{ dwe >	1.200 m = a }	-1.00	x 0.55[kPa]	=	-0.55[kPa] ↑

SIDE WIND

qz = 0.55[kPa] {theta = 0}

	dwe	Cpn	qz		
{ dwe ≤	0.600 m = a/2 }	-1.82	x 0.55[kPa]	=	-1.00[kPa] ↑
{ dwe ≤	1.200 m = a }	-1.75	x 0.55[kPa]	=	-0.96[kPa] ↑
{ dwe >	1.200 m = a }	-1.30	x 0.55[kPa]	=	-0.72[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	1.000	2.67	0.55	-0.80	-0.04	-0.06	-1.31	-1.17
Outwards	1.000		0.72		-0.04	-0.06	0.64	0.57
Inwards	1.000	2.67	0.55	-0.80	-0.04	-0.06	-1.31	-1.17
Outwards	1.000		0.96		-0.04	-0.06	0.89	0.79
Inwards	1.000	2.67	0.55	-0.80	-0.04	-0.06	-1.31	-1.17
Outwards	1.000		1.00		-0.04	-0.06	0.92	0.82

ADOPT : **PURLINS** {for canopy branch}

Stramit C7510 2-Span 1-Bridge per Span

Spacing

- @ 1000 c/c {for distance < 600 from edges}
- @ 1000 c/c {for 600 < distance from edges < 1200}
- @ 1000 c/c {for distance > 1200 from edges}

@2667mm Span w(IN) = 1.60 kN/m ↓
w(OUT) = 1.60 kN/m ↑

from Stramit Limit State Capacity Tables

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TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Reference AS/NZS 4600 - 1996 COLD-FORMED STEEL STRUCTURES

Description	LYSAGHT	C15019	ok	Rafter to Main Canopy
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MATERIAL PROPERTIES

fy	450 MPa	fu	480 MPa	E	200000 MPa	G	80000 MPa
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SECTION GEOMETRY

SECTION PROPERTIES

D	152 mm	Ix	2.01E+06 mm ⁴	ly	2.97E+05 mm ⁴	J	6.75E+02 mm
B	64 mm	Zfx	2.64E+04 mm ³	Zfy	6.53E+03 mm ³	A	560.5 mm ²
dL	17.5 mm	rx	59.869 mm	ry	23.0192 mm	Iw	1.36E+09 mm ⁶
ts	1.9 mm	x_bar	18.49 mm	y_bar	0 mm	Q	0.76
ri	5 mm	x_o	-47.07 mm	y_o	0.00 mm	ro1	79.56

phi	Moment	0.90 § 3.3.1	Tension	0.90 § 3.2.1	Buckling	0.85 § 3.4.3
With extreme fibre at fy	Zex	2.22E+04 mm ³	Ms	10.00 kNm	phi*Ms	9.00 kNm

BENDING

Segment 1 (Bending + Compression)				Segment 2 (Bending + Tension)			
LOADCASE : DL+LL				LOADCASE : DL + WL			
Provide FlyBraces at Ridge and 1st purlin 1m each side of ridge				Provide FlyBraces at Ridge and 1st purlin 1m each side of ridge			
Span = Lx = 6000 mm				Span = Lx = 6000 mm			
M1	kNm	M3	kNm	M1	kNm	M3	kNm
M2=M*	6.00 kNm	M4	kNm	M2=M*	7.75 kNm	M4	kNm
		M5	kNm			M5	kNm
Check Section Capacity ok				Check Section Capacity ok			
Cb 1.000				Cb 1.000			
Ly	2300 mm	Lz	2300 mm	Ly	1800 mm	Lz	1800 mm
foy	197.722	foz	158.036	foy	322.824	foz	248.405
Mo	7.88			Mo	12.63		
My	11.90			My	11.90		
Lambda[b]	1.23			Lambda[b]	0.97		
Mc	7.67			Mc	9.75		
fc	290.12 MPa			fc	368.80 MPa		
Zcx	2.55E+04 mm ³			Zcx	2.36E+04 mm ³		
Mb	7.38 kNm	phi*Mb	6.65 kNm	Mb	8.70 kNm	phi*Mb	7.83 kNm
M* <= phi*Ms	ok	M* <= phi*Mb	ok	M* <= phi*Ms	ok	M* <= phi*Mb	ok

Axial Compression

P=N* (+ve)	0.39 kN
Lx	6000 mm
fox	196.53
beta	0.65 E3.4.3(3)
foc	46.31 E3.4.3(1)
Lambda[c]	3.12
fn	40.62
Ae1 (f*=fy)	381.43 mm ²
Ae2 (f*=fn)	571.84 mm ²
Ns = Ae1 fy	171.65 kN
Nc = Ae2 fn	23.23 kN
Nd	19.74 kN ok

Axial Tension

P=N* (+ve)	0.64 kN
Ag	560.50
An	526.30 Hole 18 mm
kt	1
Nt	214.73 kN
Nd	193.26 kN ok

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Combined Axial Compression & Bending

Cmx	1
Ne	110.2 kN
alpha[nx]	1.00
Stability	0.93 ok
Strength	0.91 ok

Combined Axial Tension & Bending

Msxf	11.90 kNm
Stability	0.99 ok
Strength	0.73 ok

TITLE :

: Verandah, 6m Wide x 2.5m Eaves, TC3

Reference AS/NZS 4600 - 1996 COLD-FORMED STEEL STRUCTURES

Description	LYSAGHT	C15019	ok	Rafter to Canopy Branch
-------------	---------	--------	----	-------------------------

MATERIAL PROPERTIES

fy	450 MPa	fu	480 MPa	E	200000 MPa	G	80000 MPa
----	---------	----	---------	---	------------	---	-----------

SECTION GEOMETRY

SECTION PROPERTIES

D	152 mm	Ix	2.01E+06 mm ⁴	ly	2.97E+05 mm ⁴	J	6.75E+02 mm
B	64 mm	Zfx	2.64E+04 mm ³	Zfy	6.53E+03 mm ³	A	560.5 mm ²
dL	17.5 mm	rx	59.869 mm	ry	23.0192 mm	Iw	1.36E+09 mm ⁶
ts	1.9 mm	x_bar	18.49 mm	y_bar	0 mm	Q	0.76
ri	5 mm	x_o	-47.07 mm	y_o	0.00 mm	ro1	79.56

phi	Moment	0.90 § 3.3.1	Tension	0.90 § 3.2.1	Buckling	0.85 § 3.4.3
With extreme fibre at fy	Zex	2.22E+04 mm ³	Ms	10.00 kNm	phi*Ms	9.00 kNm

BENDING

Segment 1 (Bending + Compression)				Segment 2 (Bending + Tension)			
LOADCASE : DL+LL Provide FlyBrace at Ridge				LOADCASE : DL + WL Provide FlyBrace at Ridge			
Span = Lx = 5000 mm				Span = Lx = 5000 mm			
M1	kNm	M3	kNm	M1	kNm	M3	kNm
M2=M*	3.32 kNm	M4	kNm	M2=M*	5.15 kNm	M4	kNm
		M5	kNm			M5	kNm
Check Section Capacity ok				Check Section Capacity ok			
Cb 1.000				Cb 1.000			
Ly	2500 mm	Lz	2500 mm	Ly	2500 mm	Lz	2500 mm
foy	167.352	foz	136.098	foy	167.352	foz	136.098
Mo	6.73			Mo	6.73		
My	11.90			My	11.90		
Lambda[b]	1.33			Lambda[b]	1.33		
Mc	6.72			Mc	6.72		
fc	254.25 MPa			fc	254.25 MPa		
Zcx	2.59E+04 mm ³			Zcx	2.59E+04 mm ³		
Mb	6.60 kNm	phi*Mb	5.94 kNm	Mb	6.60 kNm	phi*Mb	5.94 kNm
M* <= phi*Ms	ok	M* <= phi*Mb	ok	M* <= phi*Ms	ok	M* <= phi*Mb	ok

Axial Compression

P=N* (+ve)	0.34 kN
Lx	5000 mm
fox	283.00
beta	0.65 E3.4.3(3)
foc	46.90 E3.4.3(1)
Lambda[c]	3.10
fn	41.13
Ae1 (f*=fy)	381.43 mm ²
Ae2 (f*=fn)	571.84 mm ²
Ns = Ae1 fy	171.65 kN
Nc = Ae2 fn	23.52 kN
Nd	19.99 kN ok

Axial Tension

P=N* (+ve)	0.14 kN
Ag	560.50
An	526.30 Hole 18 mm
kt	1
Nt	214.73 kN
Nd	193.26 kN ok

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Combined Axial Compression & Bending

Cmx	1
Ne	158.6 kN
alpha[nx]	1.00
Stability	0.58 ok
Strength	0.56 ok

Combined Axial Tension & Bending

Msxf	11.90 kNm
Stability	0.87 ok
Strength	0.48 ok

TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Reference AS/NZS 4600 - 1996 COLD-FORMED STEEL STRUCTURES

Description	LYSAGHT	C15019	ok	Rafter to Canopy Branch Junction
-------------	---------	--------	----	----------------------------------

MATERIAL PROPERTIES

fy	450 MPa	fu	480 MPa	E	200000 MPa	G	80000 MPa
----	---------	----	---------	---	------------	---	-----------

SECTION GEOMETRY

SECTION PROPERTIES

D	152 mm	Ix	2.01E+06 mm ⁴	Iy	2.97E+05 mm ⁴	J	6.75E+02 mm
B	64 mm	Zfx	2.64E+04 mm ³	Zfy	6.53E+03 mm ³	A	560.5 mm ²
dL	17.5 mm	rx	59.869 mm	ry	23.0192 mm	Iw	1.36E+09 mm ⁶
ts	1.9 mm	x_bar	18.49 mm	y_bar	0 mm	Q	0.76
ri	5 mm	x_o	-47.07 mm	y_o	0.00 mm	ro1	79.56

phi	Moment	0.90 § 3.3.1	Tension	0.90 § 3.2.1	Buckling	0.85 § 3.4.3
With extreme fibre at fy	Zex	2.22E+04 mm ³	Ms	10.00 kNm	phi*Ms	9.00 kNm

BENDING

Segment 1 (Bending + Compression)				Segment 2 (Bending + Tension)			
LOADCASE : DL+LL				LOADCASE : DL + WL			
Provide FlyBrace 1st Purlin 1m either side of Ridge				Provide FlyBrace 1st Purlin 1m either side of Ridge			
Span = Lx = 6000 mm				Span = Lx = 6000 mm			
M1	kNm	M3	kNm	M1	kNm	M3	kNm
M2=M*	5.52 kNm	M4	kNm	M2=M*	6.96 kNm	M4	kNm
		M5	kNm			M5	kNm
Check Section Capacity ok				Check Section Capacity ok			
Cb 1.000				Cb 1.000			
Ly	2500 mm	Lz	2500 mm	Ly	2100 mm	Lz	2100 mm
foy	167.352	foz	136.098	foy	237.176	foz	186.537
Mo	6.73			Mo	9.38		
My	11.90			My	11.90		
Lambda[b]	1.33			Lambda[b]	1.13		
Mc	6.72			Mc	8.55		
fc	254.25 MPa			fc	323.54 MPa		
Zcx	2.59E+04 mm ³			Zcx	2.46E+04 mm ³		
Mb	6.60 kNm	phi*Mb	5.94 kNm	Mb	7.95 kNm	phi*Mb	7.16 kNm
M* <= phi*Ms	ok	M* <= phi*Mb	ok	M* <= phi*Ms	ok	M* <= phi*Mb	ok

Axial Compression

P=N*	(+ve)	0.20 kN
Lx		6000 mm
fox		196.53
beta		0.65 E3.4.3(3)
foc		42.21 E3.4.3(1)
Lambda[c]		3.26
fn		37.02
Ae1 (f*=fy)		381.43 mm ²
Ae2 (f*=fn)		571.84 mm ²
Ns = Ae1 fy		171.65 kN
Nc = Ae2 fn		21.17 kN
Nd		17.99 kN ok

Axial Tension

P=N*	(+ve)	1.40 kN
Ag		560.50
An		526.30 Hole 18 mm
kt		1
Nt		214.73 kN
Nd		193.26 kN ok

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Combined Axial Compression & Bending

Cmx	1
Ne	110.2 kN
alpha[nx]	1.00
Stability	0.94 ok
Strength	0.93 ok

Combined Axial Tension & Bending

Msxf	11.90 kNm
Stability	0.97 ok
Strength	0.66 ok

TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Reference AS/NZS 4600 - 1996 COLD-FORMED STEEL STRUCTURES

Description	LYSAGHT	C15019	ok	Fascia Carry Beam
-------------	---------	--------	----	-------------------

MATERIAL PROPERTIES

fy	450 MPa	fu	480 MPa	E	200000 MPa	G	80000 MPa
----	---------	----	---------	---	------------	---	-----------

SECTION GEOMETRY

SECTION PROPERTIES

D	152 mm	Ix	2.01E+06 mm ⁴	ly	2.97E+05 mm ⁴	J	6.75E+02 mm
B	64 mm	Zfx	2.64E+04 mm ³	Zfy	6.53E+03 mm ³	A	560.5 mm ²
dL	17.5 mm	rx	59.869 mm	ry	23.0192 mm	Iw	1.36E+09 mm ⁶
ts	1.9 mm	x_bar	18.49 mm	y_bar	0 mm	Q	0.76
ri	5 mm	x_o	-47.07 mm	y_o	0.00 mm	ro1	79.56

phi	Moment	0.90 § 3.3.1	Tension	0.90 § 3.2.1	Buckling	0.85 § 3.4.3
With extreme fibre at fy	Zex	2.22E+04 mm ³	Ms	10.00 kNm	phi*Ms	9.00 kNm

BENDING

Segment 1 (Bending + Compression)				Segment 2 (Bending + Tension)			
LOADCASE : DL+LL				LOADCASE : DL + WL			
Braced at midpoint by incoming rafter segment length from midpoint to point of contraflexure				Braced at midpoint by incoming rafter Provide Vertical bridge between web of fascia beam and web of rafter over. 2 bolts to each web spaced vertically.			
Span = Lx = 6000 mm				Span = Lx = 6000 mm			
M1	kNm	M3	kNm	M1	kNm	M3	kNm
M2=M*	4.42 kNm	M4	kNm	M2=M*	5.96 kNm	M4	kNm
		M5	kNm			M5	kNm
Check Section Capacity ok				Check Section Capacity ok			
Cb 1.000				Cb 1.000			
Ly	2600 mm	Lz	2600 mm	Ly	2400 mm	Lz	2400 mm
foy	154.726	foz	126.978	foy	181.588	foz	146.382
Mo	6.25			Mo	7.27		
My	11.90			My	11.90		
Lambda[b]	1.38			Lambda[b]	1.28		
Mc	6.25			Mc	7.20		
fc	236.46 MPa			fc	272.48 MPa		
Zcx	2.62E+04 mm ³			Zcx	2.58E+04 mm ³		
Mb	6.19 kNm	phi*Mb	5.57 kNm	Mb	7.02 kNm	phi*Mb	6.32 kNm
M* <= phi*Ms	ok	M* <= phi*Mb	ok	M* <= phi*Ms	ok	M* <= phi*Mb	ok

Axial Compression

P=N* (+ve)	0.26 kN
Lx	6000 mm
fox	196.53
beta	0.65 E3.4.3(3)
foc	40.32 E3.4.3(1)
Lambda[c]	3.34
fn	35.36
Ae1 (f*=fy)	381.43 mm ²
Ae2 (f*=fn)	571.84 mm ²
Ns = Ae1 fy	171.65 kN
Nc = Ae2 fn	20.22 kN
Nd	17.19 kN ok

Axial Tension

P=N* (+ve)	0.28 kN
Ag	560.50
An	526.30 Hole 18 mm
kt	1
Nt	214.73 kN
Nd	193.26 kN ok

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Combined Axial Compression & Bending

Cmx	1
Ne	110.2 kN
alpha[nx]	1.00
Stability	0.81 ok
Strength	0.80 ok

Combined Axial Tension & Bending

Msxf	11.90 kNm
Stability	0.94 ok
Strength	0.56 ok

TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Doubly Pitched Canopy

Check Corner Column at Junction of Two Canopies

			Duragal Design Capacity Tables	
Max. Moment	Mx*	2.35 kNm	phi.Mbx	5.54 kNm
Max. Moment	My*	2.35 kNm	phi.Mby	5.54 kNm
Axial Compression	N*	4.1 kN	Nom	85.8 kN

$Mx^*/\phi . Mbx + My^*/\phi . Mby + N^*/\phi N = 0.90 < 1$ therefore ok

Therefore adopt:	COLUMNS
	65 x 65 x 2.5 SHS DuraGal C450LO

Connections

Ridge Complete Penetration Butt Weld

Eaves Max. Shear $V^* = 5.4$ kN
 adopt 8 plate Cleat
 2M16-4.6/s Bolts $\phi . Vfn = 28.6$ kN/bolt

Fascia Carry Beam

Generally Perimeter beam is just a fascia, and a nominal cleated connection will suffice.
 There is an exception where it carries the Rafter at the junction between the main frame and the canopy branch
 Here there is a small end moment of 1.9 kNm

Therefore check that a nominal cleated connection will suffice

Try Cleat Plate + Two Bolts

depth	145	phi	0.9
thickness	8		
Z	2.80E+04	mm^3	
f	250	MPa	
phi*Ms	6.31	kNm	> applied moment therefore ok !

Distance between bolts	60 mm
Shear Force in Bolts =	31.7 kN
M16-4.6/s $\phi . Vfx =$	39.9 kN/bolt threads excluded
M20-4.6/s $\phi . Vfn =$	44.6 kN/bolt threads included

$\phi . Vw =$	0.313 kN/mm	E41XX/W40X electrodes
length of weld =	145 mm	
Weld Capacity	90.8 kN	> applied shear 2.62 kN therefore ok !

Check Weld in Bending

Design of Fillet Welds (bending)

phi	0.6
fuw	410 MPa
kr	1
tw	3
tt	2.12 mm
vw	521.84 N/mm
fw=phi * Vw	313.11 N/mm

Plate Vertical Weld each side

d	145
Zw	7008.33 mm^2

$Mw = fw * Zw$
 $= 2.19E+06$ Nmm
 $= 2194.36$ kNm
 $= 2.19$ kNm

> applied moment therefore ok !

CONNECTIONS
1) Adopt 3mm minimum welds u.n.o
2) Columns complete penetration butt welded to base plates
3) Rafters complete penetration butt welded at ridges
4) Rafters to Columns: 8 Plate Cleat - 2M20-4.6/s Bolts
5) Fascia to Columns: 8 Plate Cleat - 2M20-4.6/s Bolts

TITLE :

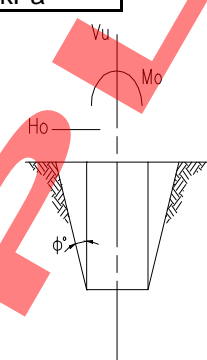
Verandah, 6m Wide x 2.5m Eaves, TC3

PIERS FOR COLUMNS

ASSUME SANDY SOIL				Density	kg/m ³	kN/m ³
active	0.27	Total cone height {D+f}	1.01	Soil	1937.00	19.00
passive	3.69	Cone Vol {V_tot}	0.54	Concrete	2400.00	23.54
soil cone {e}	0.56	Apex vol {v2}	0.01	Limit State DL load factor = 0.80 Overturning Factor = 1.00 Diameter d = 0.3 Depth D = 0.8 Vu = 6.4 Vd = 0		
apex length {}	0.21	Cylinder vol {v_cyl}	0.06			
diameter {f}	1.42	γ =	1900 kN/m ³			
		c =	0.00 kPa			
		φ =	35 = 0.61 radians			
allowable bearing pmax =				150.00 kPa		

Check Up Lift

	Volume [m ³]	Force [kN]
Soil	0.47	9.01
Concrete	0.06	1.33
cohes		0.00
DL Vd		0.00
Σ		10.34 kN



FoS = 0.80 x 10.34 / 6.40 = 1.29 > 1.00 ok

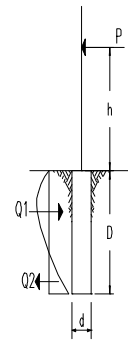
Check Over Turning

h = Mo / Ho = 2.35 / 0.94 = 2.50 m

Q2 = P(10h + 3.4D) / (5.6 D)
 = 0.94 x (10 x 2.50 + 3.4 x 0.80) / (5.6 x 0.80)
 = 5.82 kN

Q1 = Q2 + P = 6.76 kN

S1 = 6.8 / (0.68 x 0.80 x 0.30) = 41.40 => p average



P = Ho = 0.94
Mo = 2.35

pa = 1.5 x 41.40 = 62.10 < pmax ok

ADOPT : 300 DIAM. PIER x 800 DEEP

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TITLE :

Verandah, 6m Wide x 2.5m Eaves, TC3

Doubly Pitched Canopy {Fully Welded Option}

Advised by client that preference is for site welding and that structure will therefore be fully welded.

By reference to the fully fixed moment envelopes, the maximum design moments for the rafters are lower, therefore rafters ok !
 Columns however now have a maximum moment of 4 kNm at the eaves.
 The following microstran design report demonstrates columns still acceptable for the main frame.

== STEEL MEMBERS SUMMARY REPORT ==

Membr	Code	Length mm	Grade	Section Name	Crit. Ratio	Load Case	Critical Condition
1	AS4100	2500	C350	65X65X2.5SHS	1.113		9 Section N+Mx
5	AS4100	2300	C350	65X65X2.5SHS	1.897		8 Section bending
9	AS4100	200	C350	65X65X2.5SHS	6.902		8 Section N+Mx
10	AS4100	600	C350	65X65X2.5SHS	1.897		8 Section N+Mx

Check Corner Column at Junction of Two Canopies

Prior Check of corner column still valid at base but now need to check eaves.

$M_x/\phi + M_y/\phi + N/\phi \leq 1$

	Compression	Tension		Duragal Design Capacity Tables
Max. Momen	$M_x^* = 3.0$	4	kNm	$4 \phi M_x = 5.54$ kNm
Max. Momen	$M_y^* = 1.2$	1.3	kNm	$1.3 \phi M_y = 5.54$ kNm
Axial (total)	$N^* = 7.8$	9.802	kN	Nom 85.8 kN
ratio	0.859	0.999		$\phi N_t = 233$ kN
	< 1 therefore ok !	< 1 therefore ok !		

This is conservative since these are effects are on fully loaded frames, but only half loaded frames come into corner column

Therefore adopt:	COLUMNS
	65 x 65 x 2.5 SHS DuraGal C450LO

Connections

All members are fully welded. Resulting in additional welds to be checked for eaves and fascia carry beams.

Eaves & Carry Beam

Maximum Eaves Moment	4 kNm	$=M^*$	$>$ carry beam moment therefore adopt for design
Maximum Shear at Eaves	5.6 kNm	$=V^*$	

Perimeter of C-section adopt	$=150 + 2*65 = 280$ mm	$\phi V_w = 0.313$ kN/mm	E41XX/W40X electrodes
V^*	5.4 kN	$<$	87.64 kN weld capacity therefore shear ok !

Design of Fillet Welds {bending}

ϕ	0.6
f_{uw}	410 MPa
k_r	1
t_w	3
t_t	2.12 mm
v_w	521.84 N/mm
$f_w = \phi * V_w$	313.11 N/mm

Weld one side of profile of C-section

b	65
d	150
Z_w	13500.00 mm ²
$M_w = f_w * Z_w$	$= 4.23E+06$ Nmm
	$= 4226.94$ kNm
	$= 4.23$ kNm = weld capacity
	$= 8.5$ kNm = weld capacity {weld all round}
	$>$ applied moment therefore ok !

CONNECTIONS
1) Adopt 3mm minimum welds u.n.o
2) Columns complete penetration butt welded to base plates
3) Rafters complete penetration butt welded at ridges
4) Rafters to Columns: 3 cfw both sides of profile
5) Fascia to Columns: 3 cfw both sides of profile

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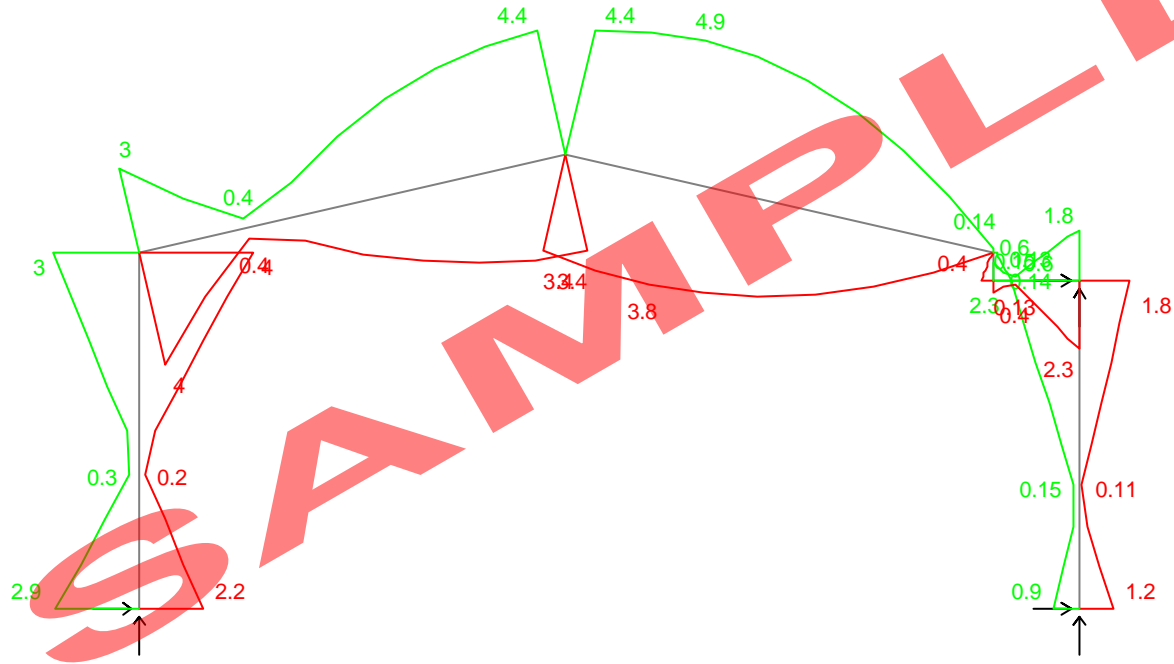
Envelope for Moment Mz

— Maximum

— Minimum

Enveloped Cases:

- 8 C WL1+0.8DL
- 9 C WL2+0.8DL
- 10 C WL3+0.8DL
- 11 C WL4+0.8DL
- 12 C 1.25DL+1.5LL
- 13 C 1.25DL+1.5PL



Y
↑
Z → X
theta: 270 phi: 0

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Main Frame - Fully Fixed Option

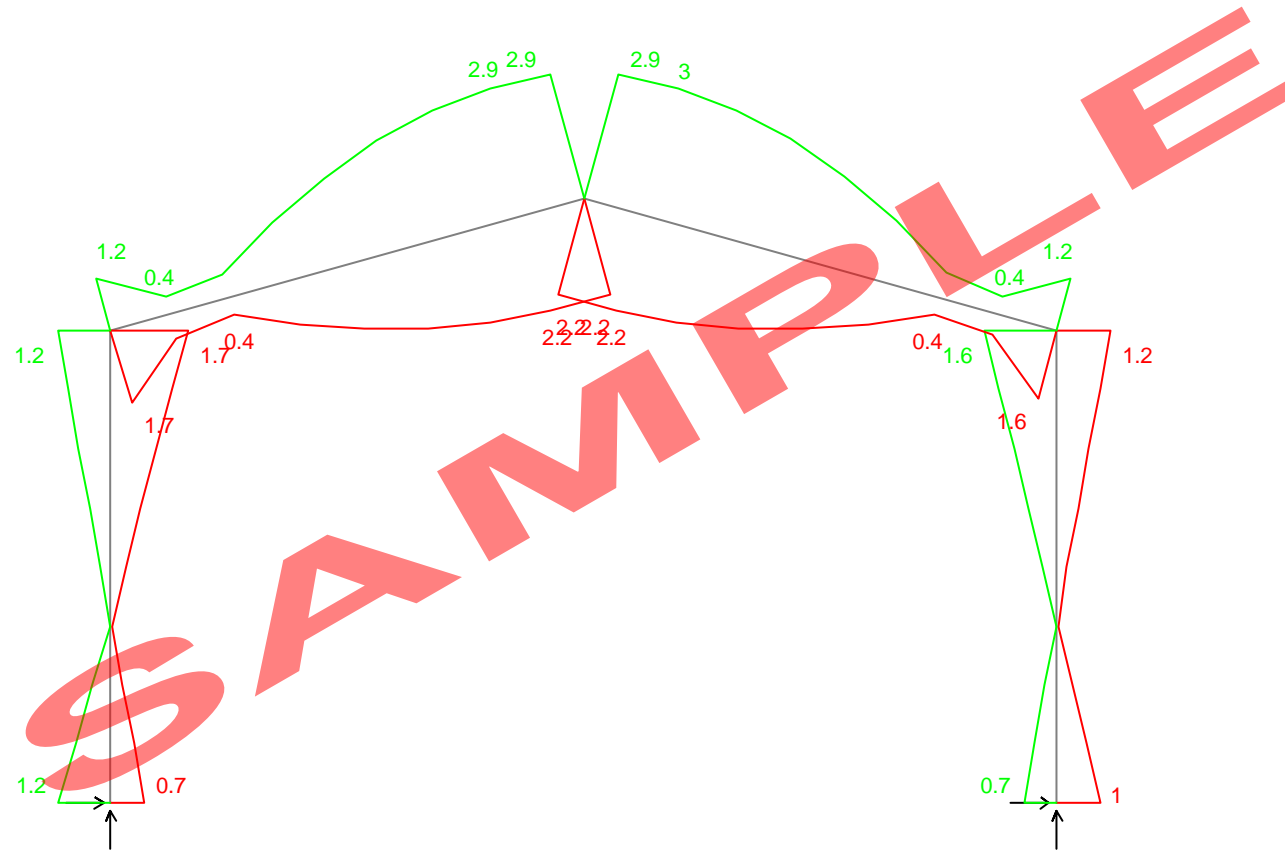
Bending Moment, Mz

Envelope for Moment Mz

- Maximum
- Minimum

Enveloped Cases:

- 8 C WL1+0.8DL
- 9 C WL2+0.8DL
- 10 C WL3+0.8DL
- 11 C WL4+0.8DL
- 12 C 1.25DL+1.5LL
- 13 C 1.25DL+1.5PL



Y
 ↑
 Z → X
 theta: 270 phi: 0

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Canopy Branch Frame - Fully Fixed Option

Bending Moment, Mz

SAMPLE

APPENDIX – A

<p>EXAMPLE</p>

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Queries relating to these computations should be directed to Roy Harrison

SCH

INPUT/ANALYSIS REPORT

Job: c985-frame1
 Title: 7 Bollen St. North Haven
 SCH
 Type: Plane frame
 Date: 15 Oct 2001
 Time: 4:54 PM

Nodes 7
 Members 6
 Spring supports 0
 Sections 21
 Materials 1
 Primary load cases 7
 Combination load cases 6

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

LOAD CASES

Case	Type	Analysis	Title
1	P	L	Wind theta=0
2	P	L	Wind theta=180
3	P	L	Wind theta=90
4	P	L	Wind theta=270
5	P	L	Deadloads
6	P	L	Liveloads
7	P	L	PointLoad
8	C	N	WL1+0.8DL
9	C	N	WL2+0.8DL
10	C	N	WL3+0.8DL
11	C	N	WL4+0.8DL
12	C	N	1.25DL+1.5LL
13	C	N	1.25DL+1.5PL

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

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NODE COORDINATES

Node	X	Y	Z	Restraint
	m	m	m	
1	6.000	2.300	0.000	000000
2	6.600	2.300	0.000	111110
3	0.000	2.500	0.000	000000
4	6.000	2.500	0.000	000000
5	3.000	3.190	0.000	000000
6	0.000	0.000	0.000	111111
7	6.600	0.000	0.000	111111

MEMBER DEFINITION

Member	A	B	C	Prop	Matl	Rel-A	Rel-B	Length
								m
1	6	3	-X	1	1	000000	000000	2.500
5	7	2	-X	1	1	000000	000000	2.300
9	4	1	X	1	1	000000	000000	0.200
10	1	2	Y	1	1	000000	000000	0.600

SCH

11	3	5	Y	108	1	000001	000000	3.078
14	4	5	Y	108	1	000001	000000	3.078

LIBRARY SECTIONS

Section	Library	Name	Axis	Comment
1	Asw	65X65X2.5SHS	Y	default
2	Asw	100X100X5.0SHS	Y	default
3	Asw	50X50X1.6SHS	Y	default
4	Asw	75X75X2.3SHS	Y	default
9	Asw	75X75X2.8SHS	Y	default

SECTIONS INPUT BY PROPERTY VALUES

Section	Name	Comment
100	C30030	Y Portal
101	C30024	Y Portal
102	C25024	Y Portal
103	C25019	Y Portal
104	C20024	Y Portal
105	C20019	Y Portal
106	C20015	Y Portal
107	C15024	Y Portal
108	C15019	Y Portal
109	C15015	Y Portal
110	C15012	Y Portal
111	C10019	Y Portal
112	C10015	Y Portal
113	C10012	Y Portal
114	C10010	Y Portal
115	C07510	Y Portal

SECTION PROPERTIES

Section	Ax	Ay	Az	J	Iy	Iz	fact
	m2	m2	m2	m4	m4	m4	
1	6.090E-04	0.000E+00	0.000E+00	6.240E-07	3.910E-07	3.910E-07	
2	1.810E-03	0.000E+00	0.000E+00	4.420E-06	2.660E-06	2.660E-06	
3	3.030E-04	0.000E+00	0.000E+00	1.850E-07	1.170E-07	1.170E-07	
4	6.550E-04	0.000E+00	0.000E+00	9.000E-07	5.710E-07	5.710E-07	
9	7.880E-04	0.000E+00	0.000E+00	1.080E-06	6.760E-07	6.760E-07	
100	1.590E-03	0.000E+00	0.000E+00	4.770E-09	1.948E-06	2.125E-05	
101	1.260E-03	0.000E+00	0.000E+00	2.419E-09	1.504E-06	1.692E-05	
102	1.020E-03	0.000E+00	0.000E+00	1.958E-09	7.160E-07	9.577E-06	
103	8.075E-04	0.000E+00	0.000E+00	9.717E-10	5.570E-07	7.585E-06	
104	9.000E-04	0.000E+00	0.000E+00	1.728E-09	6.750E-07	5.659E-06	
105	7.125E-04	0.000E+00	0.000E+00	8.574E-10	5.240E-07	4.485E-06	
106	5.550E-04	0.000E+00	0.000E+00	4.163E-10	3.930E-07	3.509E-06	
107	7.080E-04	0.000E+00	0.000E+00	1.359E-09	3.820E-07	2.527E-06	
108	5.605E-04	0.000E+00	0.000E+00	6.745E-10	2.970E-07	2.009E-06	
109	4.425E-04	0.000E+00	0.000E+00	3.319E-10	2.350E-07	1.598E-06	
110	3.540E-04	0.000E+00	0.000E+00	1.699E-10	1.860E-07	1.280E-06	
111	4.085E-04	0.000E+00	0.000E+00	4.916E-10	1.410E-07	6.670E-07	
112	3.225E-04	0.000E+00	0.000E+00	2.419E-10	1.110E-07	5.330E-07	
113	2.580E-04	0.000E+00	0.000E+00	1.238E-10	8.800E-08	4.290E-07	
114	2.150E-04	0.000E+00	0.000E+00	7.170E-11	7.500E-08	3.610E-07	
115	1.620E-04	0.000E+00	0.000E+00	5.100E-11	3.200E-08	1.440E-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

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APPLIED LOADING

CASE 1: Wind theta=0

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
1	UNIF	FX	GL		0.080			
11	UNIF	FY	GL		1.870			
14	UNIF	FY	GL		2.030			

Sum of Applied Loads (Global Axes):

FX: 0.200 FY: 12.005 FZ: 0.000

CASE 2: Wind theta=180

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		2.070			
14	UNIF	FY	GL		1.870			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 12.129 FZ: 0.000

CASE 3: Wind theta=90

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		1.560			
14	UNIF	FY	GL		1.560			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 9.604 FZ: 0.000

CASE 4: Wind theta=270

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		1.560			
14	UNIF	FY	GL		1.560			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 9.604 FZ: 0.000

CASE 5: Deadloads

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		-0.180			
14	UNIF	FY	GL		-0.180			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -1.108 FZ: 0.000

CASE 6: Liveloads

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		-0.750			
14	UNIF	FY	GL		-0.750			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -4.617 FZ: 0.000

CASE 7: PointLoad

Node Loads

Node	X Force	Y Force	Z Force	X Moment	Y Moment	Z Moment
	kN	kN	kN	kNm	kNm	kNm
5	0.000	-1.400	0.000	0.000	0.000	0.000

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Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -1.400 FZ: 0.000

CASE 8: WL1+0.8DL

Load Combinations

Case Factor
1 1.000 Wind theta=0
5 0.800 Deadloads

Sum of Applied Loads (Global Axes):

FX: 0.200 FY: 11.119 FZ: 0.000

CASE 9: WL2+0.8DL

Load Combinations

Case Factor
2 1.000 Wind theta=180
5 0.800 Deadloads

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 11.242 FZ: 0.000

CASE 10: WL3+0.8DL

Load Combinations

Case Factor
3 1.000 Wind theta=90
5 0.800 Deadloads

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 8.718 FZ: 0.000

CASE 11: WL4+0.8DL

Load Combinations

Case Factor
4 1.000 Wind theta=270
5 0.800 Deadloads

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 8.718 FZ: 0.000

CASE 12: 1.25DL+1.5LL

Load Combinations

Case Factor
5 1.250 Deadloads
6 1.500 Liveloads

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -8.311 FZ: 0.000

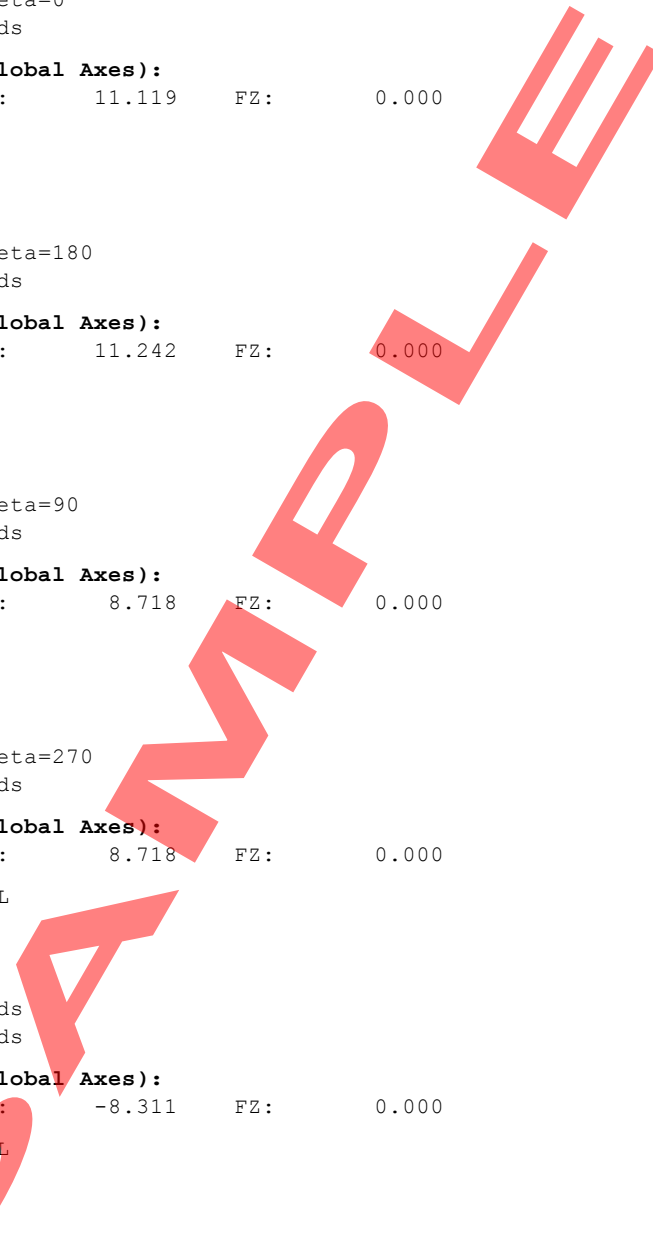
CASE 13: 1.25DL+1.5PL

Load Combinations

Case Factor
5 1.250 Deadloads
7 1.500 PointLoad

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -3.485 FZ: 0.000



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INPUT/ANALYSIS REPORT

Job: c985-frame3
 Title: Canopy Branch - Frame
 Type: Plane frame
 Date: 16 Oct 2001
 Time: 10:34 AM

Nodes 5
 Members 4
 Spring supports 0
 Sections 21
 Materials 1
 Primary load cases 7
 Combination load cases 6

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
1	P	L	Wind theta=0
2	P	L	Wind theta=180
3	P	L	Wind theta=90
4	P	L	Wind theta=270
5	P	L	Deadloads
6	P	L	Liveloads
7	P	L	PointLoad

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

NODE COORDINATES

Node	X m	Y m	Z m	Restraint
1	0.000	2.500	0.000	000000
2	5.000	2.500	0.000	000000
3	2.500	3.190	0.000	000000
4	0.000	0.000	0.000	111111
5	5.000	0.000	0.000	111111

MEMBER DEFINITION

Member	A	B	C	Prop	Matl	Rel-A	Rel-B	Length m
61	4	1	-X	1	1	000000	000000	2.500
62	5	2	-X	1	1	000000	000000	2.500
74	1	3	Y	108	1	000001	000000	2.593
79	2	3	Y	108	1	000001	000000	2.593

SECTION PROPERTY TABLE NOT PRINTED

MATERIAL TABLE NOT PRINTED

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APPLIED LOADING

CASE 1: Wind theta=0

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
61	UNIF	FX	GL		0.080			
62	UNIF	FX	GL		0.080			
74	UNIF	FY	GL		1.690			
79	UNIF	FY	GL		1.830			

Sum of Applied Loads (Global Axes):

FX: 0.400 FY: 9.129 FZ: 0.000

CASE 2: Wind theta=180

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
74	UNIF	FY	GL		1.830			
79	UNIF	FY	GL		1.690			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 9.129 FZ: 0.000

CASE 3: Wind theta=90

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
74	UNIF	FY	GL		1.410			
79	UNIF	FY	GL		1.410			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 7.314 FZ: 0.000

CASE 4: Wind theta=270

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
74	UNIF	FY	GL		1.410			
79	UNIF	FY	GL		1.410			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 7.314 FZ: 0.000

CASE 5: Deadloads

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
74	UNIF	FY	GL		-0.160			
79	UNIF	FY	GL		-0.160			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -0.830 FZ: 0.000

CASE 6: Liveloads

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
74	UNIF	FY	GL		-0.670			
79	UNIF	FY	GL		-0.670			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -3.475 FZ: 0.000

CASE 7: PointLoad

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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
3	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

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INPUT/ANALYSIS REPORT

Job: c985-frame1b
 Title: Main Frame to Branch Junction
 Type: Space frame
 Date: 16 Oct 2001
 Time: 10:15 AM

Nodes 10
 Members 11
 Spring supports 0
 Sections 22
 Materials 1
 Primary load cases 7
 Combination load cases 6

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

LOAD CASES

Case	Type	Analysis	Title
1	P	L	Wind theta=0
2	P	L	Wind theta=180
3	P	L	Wind theta=90
4	P	L	Wind theta=270
5	P	L	Deadloads
6	P	L	Liveloads
7	P	L	PointLoad

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

NODE COORDINATES

Node	X m	Y m	Z m	Restraint
1	6.000	2.300	0.000	000000
2	6.600	2.300	0.000	111110
3	0.000	2.500	0.000	000000
4	6.000	2.500	0.000	000000
5	3.000	3.190	0.000	000000
7	6.600	0.000	0.000	111111
8	0.000	2.500	3.000	000000
11	0.000	0.000	3.000	111111
12	0.000	2.500	-3.000	000000
16	0.000	0.000	-3.000	111111

MEMBER DEFINITION

Member	A	B	C	Prop	Matl	Rel-A	Rel-B	Length m
5	7	2	-X	1	1	000000	000000	2.300
9	4	1	X	1	1	000000	000000	0.200
10	1	2	Y	1	1	000000	000000	0.600
11	3	5	Y	108	1	000000	000000	3.078
14	4	5	Y	108	1	000000	000000	3.078
15	11	8	-X	1	1	000000	000000	2.500
16	3	8	Y	108	1	000000	000000	3.000
17	12	3	Y	108	1	000000	000000	3.000

18	16	12	-X	1	1	000000	000000	2.500
19	12	5	Y	200	1	000000	000000	4.298
20	5	8	Y	200	1	000000	000000	4.298

SECTION PROPERTY TABLE NOT PRINTED

MATERIAL TABLE NOT PRINTED

APPLIED LOADING

CASE 1: Wind theta=0

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		1.870			
14	UNIF	FY	GL		2.030			
15	UNIF	FX	GL		0.080			
18	UNIF	FX	GL		0.080			

Sum of Applied Loads (Global Axes):

FX: 0.400 FY: 12.005 FZ: 0.000

CASE 2: Wind theta=180

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		2.070			
14	UNIF	FY	GL		1.870			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 12.129 FZ: 0.000

CASE 3: Wind theta=90

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		1.560			
14	UNIF	FY	GL		1.560			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 9.604 FZ: 0.000

CASE 4: Wind theta=270

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		1.560			
14	UNIF	FY	GL		1.560			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: 9.604 FZ: 0.000

CASE 5: Deadloads

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		-0.180			
14	UNIF	FY	GL		-0.180			

Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -1.108 FZ: 0.000

CASE 6: Liveloads

Member Loads

Member	Form	T	A	S	F1	X1	F2	X2
11	UNIF	FY	GL		-0.750			
14	UNIF	FY	GL		-0.750			

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Sum of Applied Loads (Global Axes):

FX: 0.000 FY: -4.617 FZ: 0.000

CASE 7: PointLoad

Node Loads

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

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Queries relating to these computations should be directed to Roy Harrison

SCH

INPUT/ANALYSIS REPORT

Job: c985-frame1

Title: **MAIN FRAME**

SCH
 Type: Plane frame
 Date: 16 Oct 2001
 Time: 09:37 AM

Nodes 7
 Members 6
 Spring supports 0
 Sections 21
 Materials 1
 Primary load cases 7
 Combination load cases 6

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

LOAD CASES

Case	Type	Analysis	Title
8	C	N	WL1+0.8DL
9	C	N	WL2+0.8DL
10	C	N	WL3+0.8DL
11	C	N	WL4+0.8DL
12	C	N	1.25DL+1.5LL
13	C	N	1.25DL+1.5PL

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

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NODE TABLE NOT PRINTED
 MEMBER TABLE NOT PRINTED
 SECTION PROPERTY TABLE NOT PRINTED
 MATERIAL TABLE NOT PRINTED

MEMBER FORCES

Member	Case	Node	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	8	6	5.456	<u>-0.800</u>	0.000	0.000	0.000	<u>-1.750</u>
		3	5.452	-0.600	0.000	0.000	0.000	0.000
	9	6	<u>5.792</u>	-0.674	0.000	0.000	0.000	-1.685
		3	5.792	-0.674	0.000	0.000	0.000	0.000
	10	6	4.369	-0.519	0.000	0.000	0.000	-1.297
		3	4.369	-0.519	0.000	0.000	0.000	0.000
11	6	4.369	-0.519	0.000	0.000	0.000	-1.297	
	3	4.369	-0.519	0.000	0.000	0.000	0.000	
12	6	<u>-4.148</u>	0.452	0.000	0.000	0.000	<u>1.129</u>	
	3	-4.148	0.452	0.000	0.000	0.000	0.000	
13	6	-1.740	0.252	0.000	0.000	0.000	0.630	
	3	-1.740	0.252	0.000	0.000	0.000	0.000	
5	8	7	0.000	2.095	0.000	0.000	0.000	1.606
		2	0.000	<u>2.095</u>	0.000	0.000	0.000	<u>-3.213</u>
	9	7	0.000	2.002	0.000	0.000	0.000	1.535
		2	0.000	2.002	0.000	0.000	0.000	-3.070

SCH

10	7	0.000	1.608	0.000	0.000	0.000	1.233
	2	0.000	1.608	0.000	0.000	0.000	-2.465
11	7	0.000	1.608	0.000	0.000	0.000	1.233
	2	0.000	1.608	0.000	0.000	0.000	-2.465
12	7	0.000	<u>-1.593</u>	0.000	0.000	0.000	-1.221
	2	0.000	<u>-1.593</u>	0.000	0.000	0.000	<u>2.442</u>
13	7	0.000	-0.654	0.000	0.000	0.000	-0.501
	2	0.000	-0.654	0.000	0.000	0.000	1.003
9	8	4	<u>5.650</u>	0.894	0.000	0.000	0.000
	1	5.650	0.894	0.000	0.000	0.000	-0.179
9	4	5.434	0.957	0.000	0.000	0.000	0.000
	1	5.434	0.957	0.000	0.000	0.000	-0.192
10	4	4.339	0.695	0.000	0.000	0.000	0.000
	1	4.339	0.695	0.000	0.000	0.000	-0.139
11	4	4.339	0.695	0.000	0.000	0.000	0.000
	1	4.339	0.695	0.000	0.000	0.000	-0.139
12	4	<u>-4.167</u>	-0.288	0.000	0.000	0.000	0.000
	1	<u>-4.167</u>	-0.288	0.000	0.000	0.000	0.058
13	4	-1.746	-0.221	0.000	0.000	0.000	0.000
	1	-1.746	-0.221	0.000	0.000	0.000	0.044
10	8	1	<u>0.874</u>	<u>-5.653</u>	0.000	0.000	-0.179
	2	0.874	<u>-5.653</u>	0.000	0.000	0.000	<u>3.213</u>
9	1	0.939	-5.436	0.000	0.000	0.000	-0.192
	2	0.939	-5.436	0.000	0.000	0.000	3.070
10	1	0.683	-4.341	0.000	0.000	0.000	-0.139
	2	0.683	-4.341	0.000	0.000	0.000	2.465
11	1	0.683	-4.341	0.000	0.000	0.000	-0.139
	2	0.683	-4.341	0.000	0.000	0.000	2.465
12	1	<u>-0.300</u>	<u>4.166</u>	0.000	0.000	0.000	0.058
	2	<u>-0.300</u>	<u>4.166</u>	0.000	0.000	0.000	<u>-2.442</u>
13	1	-0.223	1.745	0.000	0.000	0.000	0.044
	2	-0.223	1.745	0.000	0.000	0.000	-1.003
11	8	3	2.042	5.091	0.000	0.000	0.000
	5	0.705	-0.051	0.000	0.000	0.000	<u>-7.757</u>
9	3	<u>2.204</u>	<u>5.399</u>	0.000	0.000	0.000	0.000
	5	0.712	-0.339	0.000	0.000	0.000	-7.787
10	3	1.631	4.086	0.000	0.000	0.000	0.000
	5	0.561	-0.139	0.000	0.000	0.000	-6.075
11	3	1.631	4.086	0.000	0.000	0.000	0.000
	5	0.561	-0.139	0.000	0.000	0.000	-6.075
12	3	<u>-1.235</u>	<u>-3.986</u>	0.000	0.000	0.000	0.000
	5	<u>-0.392</u>	0.083	0.000	0.000	0.000	6.007
13	3	-0.605	-1.651	0.000	0.000	0.000	0.000
	5	-0.458	-0.974	0.000	0.000	0.000	<u>4.041</u>
14	8	4	2.067	<u>5.334</u>	0.000	0.000	0.000
rafter		5	0.643	-0.294	0.000	0.000	<u>-7.757</u>
9	4	<u>2.093</u>	5.105	0.000	0.000	0.000	0.000
	5	0.788	-0.046	0.000	0.000	0.000	-7.787
10	4	1.610	4.089	0.000	0.000	0.000	0.000
	5	0.560	-0.142	0.000	0.000	0.000	-6.075
11	4	1.610	4.089	0.000	0.000	0.000	0.000
	5	0.560	-0.142	0.000	0.000	0.000	<u>-6.075</u>
12	4	-1.255	-3.984	0.000	0.000	0.000	0.000
	5	-0.392	0.081	0.000	0.000	0.000	6.007
13	4	-0.608	-1.651	0.000	0.000	0.000	0.000
	5	-0.460	-0.975	0.000	0.000	0.000	<u>4.041</u>

Positive Forces (Member Axes):

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

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SUPPORT REACTIONS

Node	Case	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
2	8	<u>-1.400</u>	<u>-5.678</u>	0.000	0.000	0.000	0.000
	9	-1.228	-5.462	0.000	0.000	0.000	0.000
	10	-1.030	-4.356	0.000	0.000	0.000	0.000
	11	-1.030	-4.356	0.000	0.000	0.000	0.000
	12	1.192	4.158	0.000	0.000	0.000	0.000
	13	0.414	1.743	0.000	0.000	0.000	0.000
6	8	<u>-0.895</u>	-5.441	0.000	0.000	0.000	<u>1.750</u>
	9	<u>-0.775</u>	<u>-5.780</u>	0.000	0.000	0.000	1.685
	10	-0.578	-4.362	0.000	0.000	0.000	1.297
	11	-0.578	-4.362	0.000	0.000	0.000	1.297
	12	<u>0.401</u>	<u>4.154</u>	0.000	0.000	0.000	<u>-1.129</u>
	13	<u>0.240</u>	<u>1.742</u>	0.000	0.000	0.000	<u>-0.630</u>
7	8	<u>2.095</u>	0.000	0.000	0.000	0.000	<u>-1.606</u>
	9	2.002	0.000	0.000	0.000	0.000	-1.535
	10	1.608	0.000	0.000	0.000	0.000	-1.233
	11	1.608	0.000	0.000	0.000	0.000	-1.233
	12	<u>-1.593</u>	0.000	0.000	0.000	0.000	<u>1.221</u>
	13	-0.654	0.000	0.000	0.000	0.000	0.501

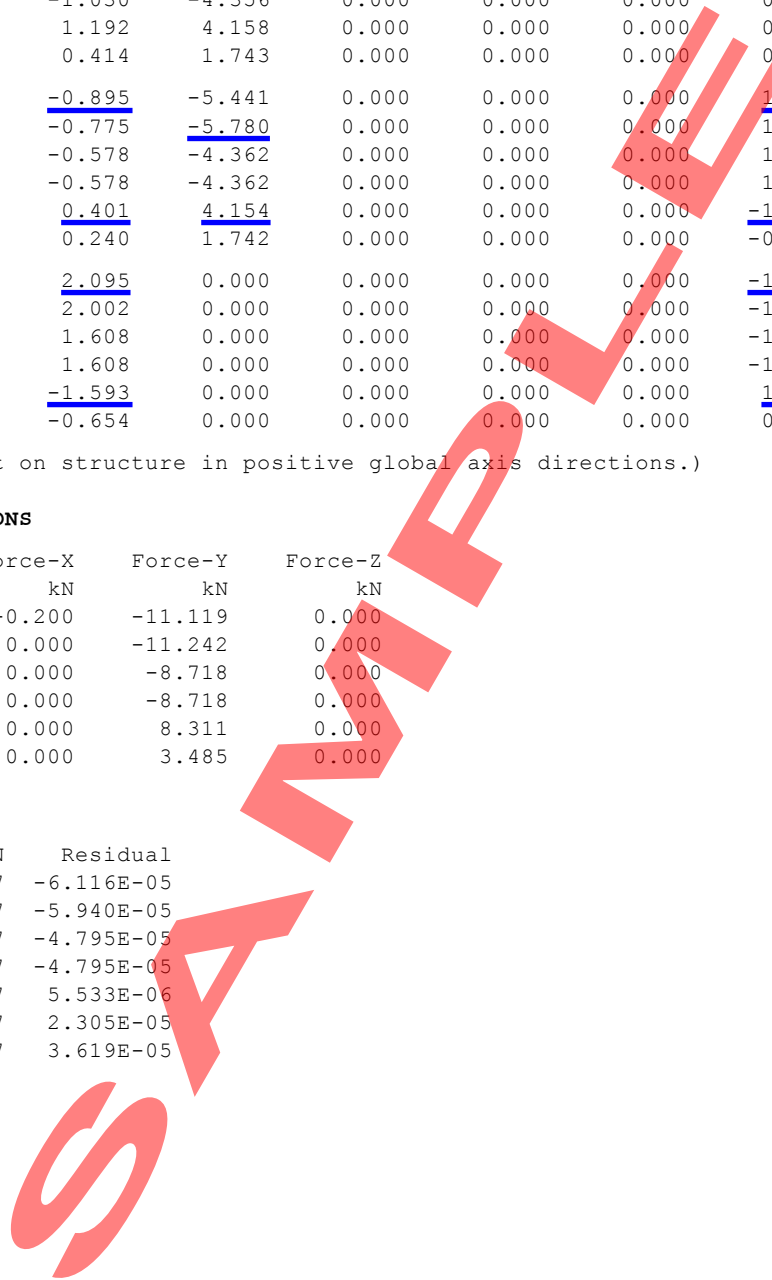
(Reactions act on structure in positive global axis directions.)

SUM OF REACTIONS

Case	Force-X kN	Force-Y kN	Force-Z kN
8	-0.200	-11.119	0.000
9	0.000	-11.242	0.000
10	0.000	-8.718	0.000
11	0.000	-8.718	0.000
12	0.000	8.311	0.000
13	0.000	3.485	0.000

RESIDUALS

Case	DOFN	Residual
1	7	-6.116E-05
2	7	-5.940E-05
3	7	-4.795E-05
4	7	-4.795E-05
5	7	5.533E-06
6	7	2.305E-05
7	7	3.619E-05



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INPUT/ANALYSIS REPORT

Job: c985-frame3
 Title: Canopy Branch - Frame
 Type: Plane frame
 Date: 16 Oct 2001
 Time: 10:35 AM

Nodes 5
 Members 4
 Spring supports 0
 Sections 21
 Materials 1
 Primary load cases 7
 Combination load cases 6

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
8	C	N	WL1+0.8DL
9	C	N	WL2+0.8DL
10	C	N	WL3+0.8DL
11	C	N	WL4+0.8DL
12	C	N	1.25DL+1.5LL
13	C	N	1.25DL+1.5PL

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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

Member	Case	Node	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
61	8	4	4.145	-0.344	0.000	0.000	0.000	-0.609
		1	4.143	-0.144	0.000	0.000	0.000	0.000
	9	4	4.324	-0.150	0.000	0.000	0.000	-0.376
		1	4.324	-0.150	0.000	0.000	0.000	0.000
	10	4	3.325	-0.117	0.000	0.000	0.000	-0.294
		1	3.325	-0.117	0.000	0.000	0.000	0.000
	11	4	3.325	-0.117	0.000	0.000	0.000	-0.294
		1	3.325	-0.117	0.000	0.000	0.000	0.000
	12	4	-3.125	0.104	0.000	0.000	0.000	0.260
		1	-3.125	0.104	0.000	0.000	0.000	0.000
13	4	-1.569	0.074	0.000	0.000	0.000	0.185	
	1	-1.569	0.074	0.000	0.000	0.000	0.000	
62	8	5	4.323	-0.042	0.000	0.000	0.000	0.144
		2	4.324	0.158	0.000	0.000	0.000	0.000
	9	5	4.143	0.151	0.000	0.000	0.000	0.377
		2	4.143	0.151	0.000	0.000	0.000	0.000
	10	5	3.325	0.117	0.000	0.000	0.000	0.294

	2	3.325	0.117	0.000	0.000	0.000	0.000
11	5	3.325	0.117	0.000	0.000	0.000	0.294
	2	3.325	0.117	0.000	0.000	0.000	0.000
12	5	<u>-3.125</u>	-0.104	0.000	0.000	0.000	-0.260
	2	-3.125	-0.104	0.000	0.000	0.000	0.000
13	5	-1.569	-0.074	0.000	0.000	0.000	-0.185
	2	-1.569	-0.074	0.000	0.000	0.000	0.000
74	8	1	1.319	3.930	0.000	0.000	0.000
	3	0.187	0.041	0.000	0.000	0.000	-5.149
9	1	1.370	4.105	0.000	0.000	0.000	0.000
	3	0.136	-0.134	0.000	0.000	0.000	<u>-5.149</u>
10	1	1.042	3.160	0.000	0.000	0.000	0.000
	3	0.123	-0.035	0.000	0.000	0.000	-4.052
11	1	1.042	3.160	0.000	0.000	0.000	0.000
	3	0.123	-0.035	0.000	0.000	0.000	-4.052
12	1	-0.892	-2.997	0.000	0.000	0.000	0.000
	3	-0.092	0.024	0.000	0.000	0.000	3.854
13	1	-0.475	-1.497	0.000	0.000	0.000	0.000
	3	-0.340	-0.996	0.000	0.000	0.000	3.232
79	8	2	1.370	4.105	0.000	0.000	0.000
	3	0.136	-0.134	0.000	0.000	0.000	-5.149
9	2	1.319	3.930	0.000	0.000	0.000	0.000
	3	0.187	0.041	0.000	0.000	0.000	-5.149
10	2	1.042	3.160	0.000	0.000	0.000	0.000
	3	0.123	-0.035	0.000	0.000	0.000	-4.052
11	2	1.042	3.160	0.000	0.000	0.000	0.000
	3	0.123	-0.035	0.000	0.000	0.000	-4.052
12	2	-0.892	-2.997	0.000	0.000	0.000	0.000
	3	-0.092	0.024	0.000	0.000	0.000	3.854
13	2	-0.475	-1.497	0.000	0.000	0.000	0.000
	3	-0.340	-0.996	0.000	0.000	0.000	3.232

Positive Forces (Member Axes):

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

SUPPORT REACTIONS

Node	Case	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
4	8	-0.367	-4.142	0.000	0.000	0.000	0.609
	9	-0.167	-4.324	0.000	0.000	0.000	0.376
	10	-0.128	-3.325	0.000	0.000	0.000	0.294
	11	-0.128	-3.325	0.000	0.000	0.000	0.294
	12	0.095	3.125	0.000	0.000	0.000	-0.260
	13	0.071	1.569	0.000	0.000	0.000	-0.185
5	8	-0.033	-4.323	0.000	0.000	0.000	-0.144
	9	0.167	-4.142	0.000	0.000	0.000	-0.377
	10	0.128	-3.325	0.000	0.000	0.000	-0.294
	11	0.128	-3.325	0.000	0.000	0.000	-0.294
	12	-0.095	3.125	0.000	0.000	0.000	0.260
	13	-0.071	1.569	0.000	0.000	0.000	0.185

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

SUM OF REACTIONS

Case	Force-X kN	Force-Y kN	Force-Z kN
8	-0.400	-8.466	0.000
9	0.000	-8.465	0.000
10	0.000	-6.650	0.000
11	0.000	-6.650	0.000
12	0.000	6.250	0.000
13	0.000	3.137	0.000

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RESIDUALS

Case	DOFN	Residual
1	1	1.379E-13
2	1	2.420E-13
3	4	-1.097E-13
4	4	-1.097E-13
5	1	-1.292E-14
6	1	-5.579E-14
7	1	-1.675E-14

SAMPLE

EXAMPLE

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INPUT/ANALYSIS REPORT

Job: c985-frame1b
 Title: Main Frame to Branch Junction
 Type: Space frame
 Date: 16 Oct 2001
 Time: 10:19 AM

Nodes 10
 Members 11
 Spring supports 0
 Sections 22
 Materials 1
 Primary load cases 7
 Combination load cases 6

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

LOAD CASES

Case	Type	Analysis	Title
8	C	N	WL1+0.8DL
9	C	N	WL2+0.8DL
10	C	N	WL3+0.8DL
11	C	N	WL4+0.8DL
12	C	N	1.25DL+1.5LL
13	C	N	1.25DL+1.5PL

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

EXAMPLE

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 24/01/2017

NODE TABLE NOT PRINTED
 MEMBER TABLE NOT PRINTED
 SECTION PROPERTY TABLE NOT PRINTED
 MATERIAL TABLE NOT PRINTED

MEMBER FORCES

Member	Case	Node	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
5	8	7	0.000	2.226	0.000	0.000	0.000	1.707
		2	0.000	<u>2.226</u>	0.000	0.000	0.000	<u>-3.413</u>
	9	7	0.000	2.176	0.000	0.000	0.000	1.668
		2	0.000	2.176	0.000	0.000	0.000	-3.336
	10	7	0.000	1.724	0.000	0.000	0.000	1.322
		2	0.000	1.724	0.000	0.000	0.000	-2.644
	11	7	0.000	1.724	0.000	0.000	0.000	1.322
		2	0.000	1.724	0.000	0.000	0.000	-2.644
	12	7	0.000	<u>-1.720</u>	0.000	0.000	0.000	-1.318
		2	0.000	<u>-1.720</u>	0.000	0.000	0.000	<u>2.637</u>
	13	7	0.000	-0.817	0.000	0.000	0.000	<u>-0.626</u>
		2	0.000	-0.817	0.000	0.000	0.000	1.252
9	8	4	<u>5.668</u>	1.681	0.000	0.000	0.000	0.344
		1	<u>5.668</u>	1.681	0.000	0.000	0.000	0.008
	9	4	5.460	1.827	0.000	0.000	0.000	0.421
		1	5.460	1.827	0.000	0.000	0.000	0.055
10	4	4.362	1.358	0.000	0.000	0.000	0.295	

		1	<u>4.362</u>	1.358	0.000	0.000	0.000	0.023
	11	4	4.362	1.358	0.000	0.000	0.000	0.295
		1	4.362	1.358	0.000	0.000	0.000	0.023
	12	4	-4.233	-0.864	0.000	0.000	0.000	-0.272
		1	-4.233	-0.864	0.000	0.000	0.000	-0.099
	13	4	-1.798	-0.519	0.000	0.000	0.000	-0.278
		1	-1.798	-0.519	0.000	0.000	0.000	-0.174
10	8	1	1.655	-5.676	0.000	0.000	0.000	0.008
		2	1.655	-5.676	0.000	0.000	0.000	3.413
	9	1	1.803	-5.468	0.000	0.000	0.000	0.055
		2	1.803	-5.468	0.000	0.000	0.000	<u>3.336</u>
	10	1	1.343	-4.367	0.000	0.000	0.000	0.023
		2	1.343	-4.367	0.000	0.000	0.000	2.644
	11	1	1.343	-4.367	0.000	0.000	0.000	0.023
		2	1.343	-4.367	0.000	0.000	0.000	2.644
	12	1	-0.881	4.230	0.000	0.000	0.000	-0.099
		2	-0.881	4.230	0.000	0.000	0.000	<u>-2.637</u>
	13	1	-0.524	1.796	0.000	0.000	0.000	-0.174
		2	-0.524	1.796	0.000	0.000	0.000	-1.252
11	rafter	8	3	1.073	4.845	0.000	0.000	0.030
		5	-0.223	-0.308	0.000	0.000	0.000	<u>-6.953</u>
	9	3	1.132	5.121	0.000	0.000	0.000	0.033
		5	-0.311	-0.629	0.000	0.000	0.000	-6.881
	10	3	0.837	3.880	0.000	0.000	0.000	0.019
		5	-0.207	-0.352	0.000	0.000	0.000	-5.410
	11	3	0.837	3.880	0.000	0.000	0.000	0.019
		5	-0.207	-0.352	0.000	0.000	0.000	-5.410
	12	3	-0.671	-3.820	0.000	0.000	0.000	0.012
		5	0.196	0.245	0.000	0.000	0.000	5.515
	13	3	-0.284	-1.541	0.000	0.000	0.000	0.001
		5	-0.135	-0.864	0.000	0.000	0.000	<u>3.703</u>
14	rafter	8	4	2.841	5.185	0.000	0.000	0.344
		5	1.397	-0.439	0.000	0.000	0.000	<u>-6.961</u>
	9	4	2.945	4.948	0.000	0.000	0.000	0.421
		5	1.623	-0.198	0.000	0.000	0.000	-6.890
	10	4	2.262	3.969	0.000	0.000	0.000	0.295
		5	1.201	-0.259	0.000	0.000	0.000	-5.416
	11	4	2.262	3.969	0.000	0.000	0.000	0.295
		5	1.201	-0.259	0.000	0.000	0.000	-5.416
	12	4	-1.831	-3.913	0.000	0.000	0.000	-0.272
		5	-0.980	0.154	0.000	0.000	0.000	<u>5.514</u>
	13	4	-0.916	-1.632	0.000	0.000	0.000	-0.278
		5	-0.768	-0.955	0.000	0.000	0.000	3.703
15	corner column	8	11	2.713	-0.878	-1.076	0.081	-0.895
		8	2.709	-0.678	-1.076	0.081	1.794	0.003
	9	11	2.874	-0.754	-1.138	0.085	-0.947	-1.882
		8	<u>2.874</u>	-0.754	-1.138	0.085	1.897	0.002
	10	11	2.168	-0.581	-0.861	0.061	-0.717	-1.449
		8	2.168	-0.581	-0.861	0.061	1.436	0.003
	11	11	2.168	-0.581	-0.861	0.061	-0.717	-1.449
		8	2.168	-0.581	-0.861	0.061	1.436	0.003
	12	11	<u>-2.046</u>	0.524	0.843	-0.037	0.703	<u>1.308</u>
		8	-2.046	0.524	0.843	-0.037	-1.404	-0.003
	13	11	-0.846	0.279	0.341	-0.017	0.284	0.698
		8	-0.846	0.279	0.341	-0.017	-0.567	-0.001
16	facia carry beam	8	3	0.296	-2.477	-0.070	-0.001	-0.165
		8	0.296	-2.477	-0.070	-0.001	0.044	1.790
	9	3	0.278	-2.618	-0.073	-0.001	-0.174	<u>-5.961</u>
		8	0.278	-2.618	-0.073	-0.001	0.047	1.894
	10	3	0.204	-1.982	-0.058	-0.001	-0.135	-4.512
		8	0.204	-1.982	-0.058	-0.001	0.038	1.433
	11	3	0.204	-1.982	-0.058	-0.001	-0.135	-4.512

17
 fascia
 carry
 beam

	8		0.204	-1.982	-0.058	-0.001	0.038	1.433
12	3		-0.262	1.940	0.071	0.001	0.155	<u>4.417</u>
	8		-0.262	1.940	0.071	0.001	-0.057	-1.404
13	3		-0.039	0.783	0.027	0.000	0.060	1.782
	8		-0.039	0.783	0.027	0.000	-0.021	-0.567
8	12		0.296	2.477	0.070	0.001	0.044	1.790
	3		0.296	2.477	0.070	0.001	-0.165	-5.640
9	12		0.278	2.618	0.073	0.001	0.047	1.894
	3		0.278	2.618	0.073	0.001	-0.174	<u>-5.961</u>
10	12		0.204	1.982	0.058	0.001	0.038	1.433
	3		0.204	1.982	0.058	0.001	-0.135	-4.512
11	12		0.204	1.982	0.058	0.001	0.038	1.433
	3		0.204	1.982	0.058	0.001	-0.135	-4.512
12	12		-0.262	-1.940	-0.071	-0.001	-0.057	-1.404
	3		-0.262	-1.940	-0.071	-0.001	0.155	<u>4.417</u>
13	12		-0.039	-0.783	-0.027	0.000	-0.021	-0.567
	3		-0.039	-0.783	-0.027	0.000	0.060	1.782
18	8	16	2.713	-0.878	1.076	-0.081	0.895	<u>-1.942</u>
	12		2.709	-0.678	1.076	-0.081	-1.794	0.003
9	16		2.874	-0.754	1.138	-0.085	0.947	-1.882
	12		2.874	-0.754	1.138	-0.085	-1.897	0.002
10	16		2.168	-0.581	0.861	-0.061	0.717	-1.449
	12		2.168	-0.581	0.861	-0.061	-1.436	0.003
11	16		2.168	-0.581	0.861	-0.061	0.717	-1.449
	12		2.168	-0.581	0.861	-0.061	-1.436	0.003
12	16		-2.046	0.524	-0.843	0.037	-0.703	1.308
	12		-2.046	0.524	-0.843	0.037	1.404	-0.003
13	16		-0.846	0.279	-0.341	0.017	-0.284	0.698
	12		-0.846	0.279	-0.341	0.017	0.567	-0.001
19	8	12	1.159	0.003	0.001	0.001	0.001	0.008
	5		1.159	0.003	0.001	0.001	-0.001	-0.006
9	12		1.278	0.003	0.001	0.001	0.001	0.008
	5		1.278	0.003	0.001	0.001	-0.001	-0.006
10	12		0.969	0.003	0.000	0.000	0.001	0.006
	5		0.969	0.003	0.000	0.000	-0.001	-0.005
11	12		0.969	0.003	0.000	0.000	0.001	0.006
	5		0.969	0.003	0.000	0.000	-0.001	-0.005
12	12		-0.806	0.000	0.000	0.000	0.000	0.000
	5		-0.806	0.000	0.000	0.000	0.000	0.000
13	12		-0.429	0.000	0.000	0.000	0.000	0.000
	5		-0.429	0.000	0.000	0.000	0.000	0.000
20	8	5	1.159	-0.003	-0.001	-0.001	-0.001	-0.006
	8		1.159	-0.003	-0.001	-0.001	0.001	0.008
9	5		1.278	-0.003	-0.001	-0.001	-0.001	-0.006
	8		1.278	-0.003	-0.001	-0.001	0.001	0.008
10	5		0.969	-0.003	0.000	0.000	-0.001	-0.005
	8		0.969	-0.003	0.000	0.000	0.001	0.006
11	5		0.969	-0.003	0.000	0.000	-0.001	-0.005
	8		0.969	-0.003	0.000	0.000	0.001	0.006
12	5		-0.806	0.000	0.000	0.000	0.000	0.000
	8		-0.806	0.000	0.000	0.000	0.000	0.000
13	5		-0.429	0.000	0.000	0.000	0.000	0.000
	8		-0.429	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

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SUPPORT REACTIONS

Node	Case	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
2	8	-0.764	-5.729	0.000	0.000	0.000	0.000
	9	-0.555	-5.525	0.000	0.000	0.000	0.000
	10	-0.496	-4.400	0.000	0.000	0.000	0.000
	11	-0.496	-4.400	0.000	0.000	0.000	0.000
	12	0.728	4.205	0.000	0.000	0.000	0.000
	13	0.270	1.790	0.000	0.000	0.000	0.000
7	8	2.226	0.000	0.000	0.000	0.000	-1.707
	9	2.176	0.000	0.000	0.000	0.000	-1.668
	10	1.724	0.000	0.000	0.000	0.000	-1.322
	11	1.724	0.000	0.000	0.000	0.000	-1.322
	12	-1.720	0.000	0.000	0.000	0.000	1.318
	13	-0.817	0.000	0.000	0.000	0.000	0.626
11	8	-0.931	-2.695	1.076	0.894	-0.099	<u>1.942</u>
	9	-0.810	-2.859	1.138	0.945	-0.104	1.882
	10	-0.614	-2.159	0.862	0.716	-0.072	1.449
	11	-0.614	-2.159	0.862	0.716	-0.072	1.449
	12	0.496	2.053	-0.843	-0.703	0.027	-1.308
	13	0.273	0.848	-0.341	-0.284	0.015	-0.698
16	8	-0.931	-2.695	-1.076	-0.894	0.099	1.942
	9	-0.810	-2.859	-1.138	-0.945	0.104	1.882
	10	-0.614	-2.159	-0.862	-0.716	0.072	1.449
	11	-0.614	-2.159	-0.862	-0.716	0.072	1.449
	12	0.496	2.053	0.843	0.703	-0.027	-1.308
	13	0.273	0.848	0.341	0.284	-0.015	-0.698

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

SUM OF REACTIONS

Case	Force-X kN	Force-Y kN	Force-Z kN
8	-0.400	-11.119	0.000
9	0.000	-11.242	0.000
10	0.000	-8.718	0.000
11	0.000	-8.718	0.000
12	0.000	8.311	0.000
13	0.000	3.485	0.000

RESIDUALS

Case	DOFN	Residual
1	20	1.053E-06
2	20	1.055E-06
3	20	8.356E-07
4	20	8.356E-07
5	20	-9.642E-08
6	20	-4.017E-07
7	20	-1.694E-07

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APPENDIX - C

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Queries relating to these computations should be directed to Roy Harrison

SCH

INPUT/ANALYSIS REPORT

Job: c985-frame1

Title: - Fully Welded

SCH

Type: Plane frame

Date: 17 Oct 2001

Time: 1:05 PM

Nodes 7
 Members 6
 Spring supports 0
 Sections 21
 Materials 1
 Primary load cases 7
 Combination load cases 6

Analysis: Non-linear elastic

Update node coordinates Y

Small displacement theory Y

Include axial force effects Y

Include flexural shortening N

Convergence criterion: Displacement

Convergence tolerance 5.000E-04

LOAD CASES

Case	Type	Analysis	Title
8	C	N	WL1+0.8DL
9	C	N	WL2+0.8DL
10	C	N	WL3+0.8DL
11	C	N	WL4+0.8DL
12	C	N	1.25DL+1.5LL
13	C	N	1.25DL+1.5PL

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

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MEMBER FORCES

Member	Case	Node	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	8	6	6.141	-2.850	0.000	0.000	0.000	-2.933
		3	6.139	-2.650	0.000	0.000	0.000	3.941
	9	6	6.476	-2.749	0.000	0.000	0.000	-2.882
		3	6.476	-2.749	0.000	0.000	0.000	3.990
	10	6	4.902	-2.137	0.000	0.000	0.000	-2.246
		3	4.902	-2.137	0.000	0.000	0.000	3.098
11	6	4.902	-2.137	0.000	0.000	0.000	-2.246	
	3	4.902	-2.137	0.000	0.000	0.000	3.098	
12	6	-4.640	2.072	0.000	0.000	0.000	2.185	
	3	-4.640	2.072	0.000	0.000	0.000	-2.994	
13	6	-1.981	1.114	0.000	0.000	0.000	1.182	
	3	-1.981	1.114	0.000	0.000	0.000	-1.603	
5	8	7	0.000	1.527	0.000	0.000	0.000	1.171
		2	0.000	1.527	0.000	0.000	0.000	-2.342
	9	7	0.000	1.470	0.000	0.000	0.000	1.127
		2	0.000	1.470	0.000	0.000	0.000	-2.255

SCH

10	7	0.000	1.175	0.000	0.000	0.000	0.901
	2	0.000	1.175	0.000	0.000	0.000	-1.801
11	7	0.000	1.175	0.000	0.000	0.000	0.901
	2	0.000	1.175	0.000	0.000	0.000	-1.801
12	7	0.000	-1.163	0.000	0.000	0.000	-0.892
	2	0.000	-1.163	0.000	0.000	0.000	1.784
13	7	0.000	-0.537	0.000	0.000	0.000	-0.412
	2	0.000	-0.537	0.000	0.000	0.000	0.824
9	8	4	4.942	2.825	0.000	0.000	-0.059
	1	4.942	2.825	0.000	0.000	0.000	-0.624
9	4	4.728	2.918	0.000	0.000	0.000	0.000
	1	4.728	2.918	0.000	0.000	0.000	-0.583
10	4	3.793	2.244	0.000	0.000	0.000	-0.026
	1	3.793	2.244	0.000	0.000	0.000	-0.475
11	4	3.793	2.244	0.000	0.000	0.000	-0.026
	1	3.793	2.244	0.000	0.000	0.000	-0.475
12	4	-3.692	-1.973	0.000	0.000	0.000	0.035
	1	-3.692	-1.973	0.000	0.000	0.000	0.430
13	4	-1.509	-1.093	0.000	0.000	0.000	-0.138
	1	-1.509	-1.093	0.000	0.000	0.000	0.081
10	8	1	2.821	-4.944	0.000	0.000	-0.625
	2	2.821	-4.944	0.000	0.000	0.000	2.342
9	1	2.914	-4.730	0.000	0.000	0.000	-0.583
	2	2.914	-4.730	0.000	0.000	0.000	2.255
10	1	2.240	-3.794	0.000	0.000	0.000	-0.475
	2	2.240	-3.794	0.000	0.000	0.000	1.802
11	1	2.240	-3.794	0.000	0.000	0.000	-0.475
	2	2.240	-3.794	0.000	0.000	0.000	1.802
12	1	-1.976	3.690	0.000	0.000	0.000	0.430
	2	-1.976	3.690	0.000	0.000	0.000	-1.784
13	1	-1.094	1.508	0.000	0.000	0.000	0.081
	2	-1.094	1.508	0.000	0.000	0.000	-0.824
11	8	3	4.097	5.284	0.000	0.000	3.941
	5	2.822	0.126	0.000	0.000	0.000	-4.386
9	3	4.275	5.588	0.000	0.000	0.000	3.990
	5	2.854	-0.169	0.000	0.000	0.000	-4.351
10	3	3.268	4.233	0.000	0.000	0.000	3.098
	5	2.237	-0.003	0.000	0.000	0.000	-3.414
11	3	3.268	4.233	0.000	0.000	0.000	3.098
	5	2.237	-0.003	0.000	0.000	0.000	-3.414
12	3	-2.978	-4.117	0.000	0.000	0.000	-2.994
	5	-2.098	-0.056	0.000	0.000	0.000	3.429
13	3	-1.511	-1.697	0.000	0.000	0.000	-1.603
	5	-1.361	-1.021	0.000	0.000	0.000	2.581
14	8	4	3.813	4.227	0.000	0.000	-0.059
	5	2.445	-1.416	0.000	0.000	0.000	-4.386
9	4	3.861	3.996	0.000	0.000	0.000	0.001
	5	2.609	-1.168	0.000	0.000	0.000	-4.351
10	4	3.008	3.220	0.000	0.000	0.000	-0.026
	5	1.992	-1.019	0.000	0.000	0.000	-3.414
11	4	3.008	3.220	0.000	0.000	0.000	-0.026
	5	1.992	-1.019	0.000	0.000	0.000	-3.414
12	4	-2.777	-3.132	0.000	0.000	0.000	0.035
	5	-1.883	0.927	0.000	0.000	0.000	3.429
13	4	-1.408	-1.221	0.000	0.000	0.000	-0.138
	5	-1.256	-0.545	0.000	0.000	0.000	2.581

Positive Forces (Member Axes):

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

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SUPPORT REACTIONS

Node	Case	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
2	8	1.183	-5.006	0.000	0.000	0.000	0.000
	9	1.341	-4.792	0.000	0.000	0.000	0.000
	10	1.000	-3.832	0.000	0.000	0.000	0.000
	11	1.000	-3.832	0.000	0.000	0.000	0.000
	12	-0.875	3.656	0.000	0.000	0.000	0.000
	13	-0.569	1.500	0.000	0.000	0.000	0.000
6	8	-2.909	-6.113	0.000	0.000	0.000	2.933
	9	-2.811	-6.450	0.000	0.000	0.000	2.882
	10	-2.174	-4.885	0.000	0.000	0.000	2.246
	11	-2.174	-4.885	0.000	0.000	0.000	2.246
	12	2.038	4.655	0.000	0.000	0.000	-2.185
	13	1.106	1.985	0.000	0.000	0.000	-1.182
7	8	1.527	0.000	0.000	0.000	0.000	-1.171
	9	1.470	0.000	0.000	0.000	0.000	-1.127
	10	1.175	0.000	0.000	0.000	0.000	-0.901
	11	1.175	0.000	0.000	0.000	0.000	-0.901
	12	-1.163	0.000	0.000	0.000	0.000	0.892
	13	-0.537	0.000	0.000	0.000	0.000	0.412

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

SUM OF REACTIONS

Case	Force-X kN	Force-Y kN	Force-Z kN
8	-0.200	-11.119	0.000
9	0.000	-11.242	0.000
10	0.000	-8.718	0.000
11	0.000	-8.718	0.000
12	0.000	8.311	0.000
13	0.000	3.485	0.000

RESIDUALS

Case	DOFN	Residual
1	9	4.839E-04
2	9	4.752E-04
3	9	3.807E-04
4	9	3.807E-04
5	9	-4.393E-05
6	9	-1.830E-04
7	9	-7.944E-05

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INPUT/ANALYSIS REPORT

Job: c985-frame3
Title: Canopy Branch - Frame - Fully Welded
 Type: Plane frame
 Date: 17 Oct 2001
 Time: 1:09 PM

Nodes 5
 Members 4
 Spring supports 0
 Sections 21
 Materials 1
 Primary load cases 7
 Combination load cases 6

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
8	C	N	WL1+0.8DL
9	C	N	WL2+0.8DL
10	C	N	WL3+0.8DL
11	C	N	WL4+0.8DL
12	C	N	1.25DL+1.5LL
13	C	N	1.25DL+1.5PL

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

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NODE TABLE NOT PRINTED
 MEMBER TABLE NOT PRINTED
 SECTION PROPERTY TABLE NOT PRINTED
 MATERIAL TABLE NOT PRINTED

MEMBER FORCES

Member	Case	Node	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
61	8	4	4.174	-1.244	0.000	0.000	0.000	-1.166
		1	4.173	-1.044	0.000	0.000	0.000	1.695
	9	4	4.327	-1.047	0.000	0.000	0.000	-0.990
		1	4.327	-1.047	0.000	0.000	0.000	1.628
	10	4	3.326	-0.823	0.000	0.000	0.000	-0.783
		1	3.326	-0.823	0.000	0.000	0.000	1.276
11	4	3.326	-0.823	0.000	0.000	0.000	-0.783	
	1	3.326	-0.823	0.000	0.000	0.000	1.276	
12	4	-3.124	0.778	0.000	0.000	0.000	0.746	
	1	-3.124	0.778	0.000	0.000	0.000	-1.200	
13	4	-1.568	0.529	0.000	0.000	0.000	0.510	
	1	-1.568	0.529	0.000	0.000	0.000	-0.812	
62	8	5	4.296	0.851	0.000	0.000	0.000	0.823
		2	4.296	1.051	0.000	0.000	0.000	-1.554
	9	5	4.142	1.047	0.000	0.000	0.000	0.998
		2	4.142	1.047	0.000	0.000	0.000	-1.621
	10	5	3.326	0.823	0.000	0.000	0.000	0.783

	2	3.326	0.823	0.000	0.000	0.000	-1.276
11	5	3.326	0.823	0.000	0.000	0.000	0.783
	2	3.326	0.823	0.000	0.000	0.000	-1.276
12	5	-3.124	-0.778	0.000	0.000	0.000	-0.746
	2	-3.124	-0.778	0.000	0.000	0.000	1.200
13	5	-1.568	-0.529	0.000	0.000	0.000	-0.510
	2	-1.568	-0.529	0.000	0.000	0.000	0.812
74	8	1	2.155	3.723	0.000	0.000	1.695
	3	1.048	-0.174	0.000	0.000	0.000	-2.908
9	1	2.197	3.872	0.000	0.000	0.000	1.628
	3	0.991	-0.374	0.000	0.000	0.000	-2.908
10	1	1.701	2.975	0.000	0.000	0.000	1.276
	3	0.798	-0.225	0.000	0.000	0.000	-2.289
11	1	1.701	2.975	0.000	0.000	0.000	1.276
	3	0.798	-0.225	0.000	0.000	0.000	-2.289
12	1	-1.562	-2.815	0.000	0.000	0.000	-1.200
	3	-0.747	0.202	0.000	0.000	0.000	2.189
13	1	-0.920	-1.375	0.000	0.000	0.000	-0.813
	3	-0.784	-0.875	0.000	0.000	0.000	2.105
79	8	2	2.189	3.843	0.000	0.000	1.554
	3	0.983	-0.403	0.000	0.000	0.000	-2.908
9	2	2.147	3.694	0.000	0.000	0.000	1.621
	3	1.040	-0.203	0.000	0.000	0.000	-2.908
10	2	1.701	2.975	0.000	0.000	0.000	1.276
	3	0.798	-0.225	0.000	0.000	0.000	-2.289
11	2	1.701	2.975	0.000	0.000	0.000	1.276
	3	0.798	-0.225	0.000	0.000	0.000	-2.289
12	2	-1.562	-2.815	0.000	0.000	0.000	-1.200
	3	-0.747	0.202	0.000	0.000	0.000	2.189
13	2	-0.920	-1.375	0.000	0.000	0.000	-0.813
	3	-0.784	-0.875	0.000	0.000	0.000	2.105

Positive Forces (Member Axes):

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

SUPPORT REACTIONS

Node	Case	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
4	8	-1.256	-4.170	0.000	0.000	0.000	1.166
	9	-1.056	-4.325	0.000	0.000	0.000	0.990
	10	-0.829	-3.325	0.000	0.000	0.000	0.783
	11	-0.829	-3.325	0.000	0.000	0.000	0.783
	12	0.774	3.125	0.000	0.000	0.000	-0.746
	13	0.527	1.569	0.000	0.000	0.000	-0.510
5	8	0.856	-4.295	0.000	0.000	0.000	-0.823
	9	1.056	-4.140	0.000	0.000	0.000	-0.998
	10	0.829	-3.325	0.000	0.000	0.000	-0.783
	11	0.829	-3.325	0.000	0.000	0.000	-0.783
	12	-0.774	3.125	0.000	0.000	0.000	0.746
	13	-0.527	1.569	0.000	0.000	0.000	0.510

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

SUM OF REACTIONS

Case	Force-X kN	Force-Y kN	Force-Z kN
8	-0.400	-8.465	0.000
9	0.000	-8.465	0.000
10	0.000	-6.650	0.000
11	0.000	-6.650	0.000
12	0.000	6.250	0.000
13	0.000	3.137	0.000

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RESIDUALS

Case	DOFN	Residual
1	4	5.218E-14
2	1	7.039E-14
3	7	5.085E-14
4	7	5.085E-14
5	4	-2.942E-15
6	4	-1.188E-14
7	1	-7.216E-15

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