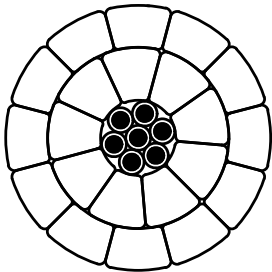
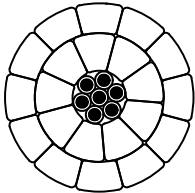
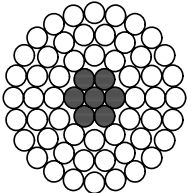
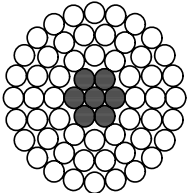


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- [7] Murthy, S.S., Santhakumar, A.R., 1990. Transmission Line Structures. McGraw-Hill Book Co. Singapore, pp. 179-180.
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Appendix B

Specification Comparison of Conductors

Description		Unit	Adoption in this project	Reference		
			Low Loss TACSR/AS 550mm ²	Low Loss ACSR/AS 550mm ²	TACSR/AS "Zebra"	ACSR "Zebra"
Nominal Diameter (*)		-	28.62	28.62	28.62	28.62
Cross Sectional Area (*)	AL	mm ²	550.4	550.4	428.9	428.9
	Core		40.08	40.08	55.59	55.59
	Total		590.5	590.5	484.5	484.5
Nominal Weight (*)		kg/km	1,814	1,814	1,555	1,621
Ultimate Tensile Strength (*)		kN	140.9	140.9	130.4	131.9
DC Resistant at 20°C (*)		Ω /km	0.0526	0.0519	0.0657	0.0674
Max. Allowable Temperature		°C	150	90	150	90
Current(A)	66°C		757	762	-	-
	75°C		-	875	767	757
	90°C		-	1,077	-	930
	136.1°C		1,514	N/A	-	N/A
	150°C		1,622	N/A	1,423	N/A
Cross Section		-				

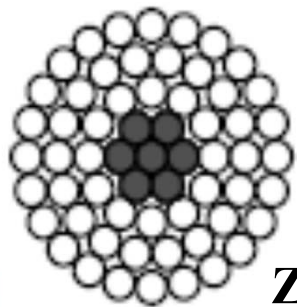
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Note : Specific values (marked:*) for above conductors are calculated in accordance with IEC 61089-1991 for ACSR "Zebra" & TACSR/AS "Zebra" and in accordance with IEC 62219-2002 for Low Loss ACSR/AS 550mm² & Low Loss TACSR/AS 550mm².

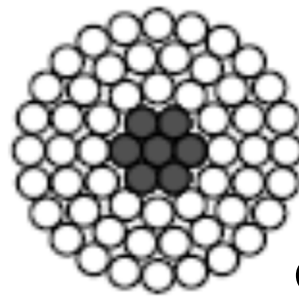
Comparison of conductor specifications

For the Zebra conductors

Option	Conductor Type	Diameter (mm)	Cross section Area (mm ²)	Weight (kg/km)	Calculated DC Resistance @ 20°C Ohms/km	Current Rating (A)
Zebra	ACSR	28.62	428	1621	0.0674	760
Rubus	AAAC	31.50	500	1620	0.0566	940
Camel	ACSR	30.18	475	1797	0.0611	820
Option 1	TACSR	28.62	428	1555	0.0657	1420
Option 2	Low Loss TACSR	28.62	550	1814	0.0519	1070



Zebra



Option 1



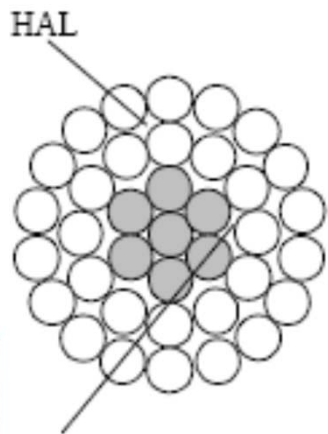
Option 2

Comparison of conductor specifications

For the Lynx conductor

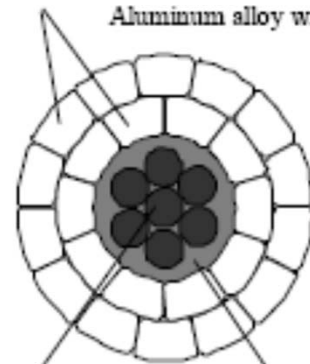
Option	Conductor Type	Diameter (mm)	Cross section Area (mm ²)	Weight (kg/km)	Calculated DC Resistance @ 20°C Ohms/km	Current Rating (A)
Lynx	ACSR	19.55	183	865	0.1576	450
Panther	ACSR	21	200	1001	0.1362	490
Option 1	GTACSR	19.2	210	851	0.140	875
Option 2	GZTACSR	18.5	195	803	0.150	920

Lynx



Option 1

TAL : Thermal resistance
Aluminum alloy wire

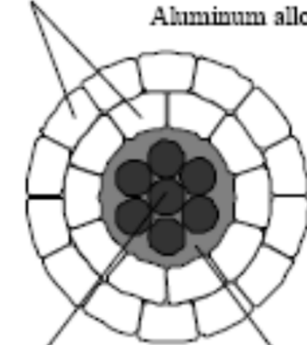


Grease

EST : Extra high strength
Galvanized Steel

Option 2

ZTAL : Extra Thermal resistance
Aluminum alloy wire



Grease

EST : Extra high strength
Galvanized Steel

Appendix C

Sag Tension Calculation

Wind force on conductor per meter run,

$$p = 970 \times 28.62 \times 10^{-3} \quad \text{N/m}$$

$$= 27.7614 \quad \text{N/m}$$

Wind force on conductor = 27.7614 N/m **27.76 N/m**

Loading factor at 15 ° C

$$\text{With wind, } Q1 = \frac{(p^2 + w^2)^{1/2}}{w}$$

Where, p - wind force on conductor per meter run
w - Weight of the conductor per meter

$$Q1 = \frac{\{(27.7614/9.80665)^2 + 1.631\}^{1/2}}{1.631}$$

Q1 = 2.0031 **2.00**

Loading factor at given temperature without wind,



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$$Q2 = \frac{1.631}{1.631}$$

Q2 = 1.0 **1.00**

Maximum allowable working tension of the conductor

Maximum working tension of ZEBRA conductor = UTS / 2.5

$$= 52760 \text{ N}$$

(Note : UTS of Insulator = 160kN, Maximum WT = 160/3 = 53.3 kN > 51.000 kN)

However in order to satisfy the design condition at 32°C , UTS/4.5

the maximum allowable working tension is assumed as = 51000 N

Maximum allowable working stress of the conductor

$$f_1 = \frac{51000}{484.5} \quad \text{N/mm}^2$$

= 105.2632 N/mm² **105.26 N/mm²**

Weight of conductor with grease/m/mm²

$$\xi = \frac{1.631 \times 9.80665}{484.5} \text{ N/m/mm}^2$$

$$\xi = 0.033013 \text{ N/m/mm}^2 \quad \mathbf{0.03 \text{ N/m/mm}^2}$$

Then the working stress f_2 can be determined by the following formula

$$f_2^2 [f_2 - (f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24 f_1^2} - \alpha t E)] = \frac{a^2 \xi^2 Q_2^2 E}{24}$$

Where $a =$ Conductor span in meters
 $E =$ Modulus of elasticity in N/mm²
 $\alpha =$ Coefficient of linear expansion in per °C
 $t =$ Temperature difference
 ($t_{\text{req}} - t_{\text{min}}$)

Then the Sag can be determined by the following formular ;

$$\text{Sag} = \frac{a^2 \xi Q_2}{8 f_2}$$

Co-ordinates of the curves can be determined by the following formular

$$\text{Sag}_{\text{req at } 15^\circ \text{C}} = \frac{\text{Equivalent Span Sag at } 15^\circ \text{C}}{(\text{Equivalent Span})} \times (\text{Required Span})^2$$


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SAG at 15°C with wind load

$$\begin{aligned} \text{Initial Tension} &= 51000 \text{ N} \\ \text{Sag} &= \frac{w \times \text{span}^2 \times Q1}{8 \times T} \quad \begin{array}{l} w - \text{unit wt of conductor} \quad \text{N/m} \\ T - \text{Initial Tension} \quad \text{N} \end{array} \\ \text{Sag} &= \frac{1.631 \times 9.80665 \times 300^{2 \times 2.0031}}{8 \times 51000} \\ &= 7.06754 \text{ m} \quad \mathbf{7.07 \text{ m}} \end{aligned}$$

SAG at 15°C without wind load

For Equivalent span (m) = 300

$$f_2^2 [f_2 - (f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24 f_1^2} - \alpha t E)] = \frac{a^2 \xi^2 Q_2^2 E}{24}$$

$$t = \frac{(15 - 15)^\circ \text{C}}{0^\circ \text{C}}$$

$$(f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24 f_1^2} - \alpha t E) = \frac{105.2632 - \{300^2 \times 0.033013^2 \times 2.0031^2 \times 69 \times 10^3\}}{24 \times 105.2632^2}$$

$$- 0.0000193 \times 0 \times 69 \times 10^3$$

$$= 105.2632 - 102.1196$$

$$= 3.1436$$

$$\frac{a^2 \cdot \xi^2 \cdot Q_2^2 \cdot E}{24} = \frac{300^2 \times 0.033013^2 \times 1^2 \times 69 \times 10^3}{24}$$

$$= 281995.429$$

Therefore the equation,

$$f_2^3 - 3.1436 f_2^2 = 281995.4292$$

Solving by Newton Raphsan methods

Starting

$$f_2 = \{281995.4292 + 3.1436 f_2^2\}^{1/3}$$

$$f_2 = 66.7$$

$$f_2 = 66.64299$$

$$f_2 = 66.64120$$

$$f_2 = 66.64114$$

$$f_2 = 66.64114$$

$$f_2 = 66.64114$$

$$f_2 = 66.64114$$

$$f_2 = 66.64114$$

$$f_2 = 66.64114$$

$$f_2 = 66.64114$$

Then

$$T = 66.64114 \times 484.5 \text{ N}$$

$$\text{Sag} = \frac{32287.632}{8 \times 66.64114} \text{ N} = 32287.63 \text{ N}$$

$$5.5730 \text{ m} \quad 5.57 \text{ m}$$

SAG at 32°C without wind load

For Equivalent span (m) = 300

$$f_2^2 [f_2 - (f_1 - \frac{a^2 \cdot \xi^2 \cdot Q_1^2 \cdot E}{24 f_1^2} - \alpha t E)] = \frac{a^2 \cdot \xi^2 \cdot Q_2^2 \cdot E}{24}$$

$$t = (32 - 15)^\circ \text{C}$$

$$17^\circ \text{C}$$

$$(f_1 - \frac{a^2 \cdot \xi^2 \cdot Q_1^2 \cdot E}{24 f_1^2} - \alpha t E) = \frac{105.2632 - \{ \frac{300^2 \times 0.033013^2 \times 2.0031^2 \times 69 \times 10^3}{24 \times 105.2632^2} \}}{24 \times 105.2632^2}$$

$$-0.0000193 \times 17 \times 69 \times 10^3$$

$$= 105.2632 - 102.1196 - 22.6389$$

$$= -19.4953$$

$$\frac{a^2 \cdot \xi^2 \cdot Q_2^2 \cdot E}{24} = \frac{300^2 \times 0.033013^2 \times 1^2 \times 69 \times 10^3}{24}$$

$$= 281995.429$$

Therefore the equation,

$$f_2^3 + 19.4953f_2^2 = 281995.4292$$

Solving by Newton Raphsan methods

$$f_2 = \{281995.4292 - 19.4953f_2^2\}^{1/3}$$

Starting

$$f_2 = 59.679000$$

$$f_2 = 59.679881$$

$$f_2 = 59.679689$$

$$f_2 = 59.679731$$

$$f_2 = 59.679722$$

$$f_2 = 59.679724$$

$$f_2 = 59.679724$$

$$f_2 = 59.679724$$

Then $T = 59.679724 \times 484.5 \quad N$

$$= 28914.826 \quad N \quad \mathbf{28914.83 \text{ N}}$$

Note : at 32°C Tension should be less than 28914.826 N **Ok**

$$\text{Sag} = \frac{300^2 \times 0.033013 \times 1}{8 \times 59.679724}$$

$$6.2231 \text{ m} \quad \mathbf{6.22 \text{ m}}$$

SAG at 75°C without wind load

For Equivalent span (m) = 300

$$f_2^2 [f_2 - (f_1 - \frac{a^2 \cdot \xi^2 \cdot Q_1^2 \cdot E}{24f_1^2} - \alpha t E)] = \frac{a^2 \cdot \xi^2 \cdot Q_2^2 \cdot E}{24}$$

$$t = (75 - 15)^\circ C$$

$$60^\circ C$$

$$(f_1 - \frac{a^2 \cdot \xi^2 \cdot Q_1^2 \cdot E}{24f_1^2} - \alpha t E) = \frac{105.2632 - \{300^2 \times 0.033013^2 \times 2.0031^2 \times 69 \times 10^3\}}{24 \times 105.2632^2}$$

$$- 0.0000193 \times 60 \times 69 \times 10^3$$

$$= 105.2632 - 102.120 - 79.902$$

$$= -76.7584$$

$$\frac{a^2 \cdot \xi^2 \cdot Q_2^2 \cdot E}{24} = \frac{300^2 \times 0.033013^2 \times 1^2 \times 69 \times 10^3}{24}$$

$$24 = \frac{24}{281995.429}$$

Therefore the equation,

$$f_2^3 + 76.7584 f_2^2 = 281995.4292$$

Solving by Newton Raphsan methods

Starting

$$f_2 = \{281995.4292 - 76.7584f_2^2\}^{1/3}$$

$$f_2 = 47.616234$$

$$f_2 = 47.6162340$$

$$f_2 = 47.6162340$$

$$f_2 = 47.6162340$$

$$f_2 = 47.6162340$$

$$f_2 = 47.6162340$$

$$f_2 = 47.6162340$$

$$f_2 = 47.6162340$$

$$f_2 = 47.6162340$$

Then

$$T = 47.6162340 \times 484.5 \quad \text{N}$$

$$23070.065 \quad \text{N}$$

23070.07 N

$$\text{Sag} = \frac{300^2 \times 0.03303 \times 1}{8 \times 47.6162340}$$



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7.80 m

Sag Tension Calculation of Proposed Low Loss Conductor

Wind force on conductor per meter run,

$$p = 970 \times 28.62 \times 10^{-3} \quad \text{N/m}$$

$$= 27.7614 \quad \text{N/m}$$

Wind force on conductor = 27.7614 N/m **27.76 N/m**

Loading factor at 15 ° C

$$\text{With wind, } Q1 = \frac{(p^2 + w^2)^{1/2}}{w}$$

Where, p - wind force on conductor per meter run

w - Weight of the conductor per meter

$$Q1 = \frac{\{(27.7614/9.80665)^2 + 1.631\}^{1/2}}{1.814}$$

Q1 = 1.8535 **1.85**

Loading factor at given temperature without wind,



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$$Q2 = \frac{\{0 + 1.631^2\}^{1/2}}{1.814}$$

Q2 = 1.0 **1.00**

Maximum allowable working tension of the conductor

Maximum working tension of Proposed Low Loss conductor = UTS / 2.5

$$= 56360 \text{ N}$$

(Note : UTS of Insulator = 160kN, Maximum WT = 160/3 = 53.3 kN > 51.000 kN)

However in order to satisfy the design condition at 32°C , UTS/4.5

the maximum allowable working tension is assumed as = 51000 N

Maximum allowable working stress of the conductor

$$f_1 = \frac{51000}{484.5} \quad \text{N/mm}^2$$

$$= 105.2632 \text{ N/mm}^2 \quad \mathbf{105.26 \text{ N/mm}^2}$$

Weight of conductor with grease/m/mm²

$$\xi = \frac{1.631 \times 9.80665}{484.5} \quad \text{N/m/mm}^2$$

$$\xi = 0.036717 \text{ N/m/mm}^2$$

$$0.04 \text{ N/m/mm}^2$$

Then the working stress f_2 can be determined by the following formula

$$f_2^2 [f_2 - (f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24f_1^2} - \alpha t E)] = \frac{a^2 \xi^2 Q_2^2 E}{24}$$

Where
 a = Conductor span in meters
 E = Modulus of elasticity in N/mm²
 α = Coefficient of linear expansion in per °C
 t = Temperature difference
 ($t_{\text{req}} - t_{\text{min}}$)

Then the Sag can be determined by the following formular ;

$$\text{Sag} = \frac{a^2 \xi Q_2}{8f_2}$$

Co-ordinates of the curves can be determined by the following formular

$$\text{Sag}_{\text{req at } 15^\circ \text{C}} = \frac{\text{Equivalent Span Sag at } 15^\circ \text{C}}{(\text{Equivalent Span})^2} \times (\text{Required Span})^2$$

SAG at 15°C with wind load



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$$\text{Initial Tension} = 51000 \text{ N}$$

$$\text{Sag} = \frac{w \times \text{span}^2 \times Q_1}{8 \times T}$$

w - unit wt of conductor N/m
 T - Initial Tension N

$$\text{Sag} = \frac{1.631 \times 9.80665 \times 300^{2 \times 2.0031}}{8 \times 51000}$$

$$= 7.27325 \text{ m} \qquad \qquad \qquad 7.27 \text{ m}$$

SAG at 15°C without wind load

For Equivalent span (m) = 300

$$f_2^2 [f_2 - (f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24f_1^2} - \alpha t E)] = \frac{a^2 \xi^2 Q_2^2 E}{24}$$

$$t = (15 - 15)^\circ \text{C} = 0^\circ \text{C}$$

$$(f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24f_1^2} - \alpha t E) = \frac{105.2632 - \{300^2 \times 0.033013^2 \times 2.0031^2 \times 69 \times 10^3\}}{24 \times 105.2632^2}$$

$$- 0.0000193 \times 0 \times 69 \times 10^3$$

$$= 105.2632 - 111.2859$$

$$= -6.0227$$

$$\frac{a^2 \xi^2 Q_2^2 E}{24} = \frac{300^2 \times 0.033013^2 \times 1^2 \times 69 \times 10^3}{24}$$

$$= 358936.786$$

Therefore the equation,

$$f_2^3 - 3.1436 f_2^2 = 281995.4292$$

Solving by Newton Raphsan methods

	$f_2 =$	$\{281995.4292 + 3.1436 f_2^2\}^{1/3}$	
Starting	$f_2 =$	66.7	
	$f_2 =$	69.25346	
	$f_2 =$	69.10784	
	$f_2 =$	69.11630	
	$f_2 =$	69.11581	
	$f_2 =$	69.11584	
	$f_2 =$	69.11584	
	$f_2 =$	69.11584	
	$f_2 =$	69.11584	N/mm ²

Then	T =	69.11584×484.5	N	
		33486.624	N	33486.62 N
	Sag =	$\frac{300^2 \times 0.033013 \times 1}{8 \times 66.64114}$		
		5.9764 m		5.98 m

SAG at 32°C without wind load

For Equivalent span (m) = 300

$$f_2^2 [f_2 - (f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24 f_1^2} - \alpha t E)] = \frac{a^2 \xi^2 Q_2^2 E}{24}$$

$$t = (32 - 15)^\circ \text{C}$$

$$17^\circ \text{C}$$

$$(f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24 f_1^2} - \alpha t E) = \frac{105.2632 - \{300^2 \times 0.033013^2 \times 2.0031^2 \times 69 \times 10^3\}}{24 \times 105.2632^2}$$

$$-0.0000193 \times 17 \times 69 \times 10^3$$

$$= 105.2632 - 111.2859 - 24.14$$

$$= -30.1627$$

$$\frac{a^2 \xi^2 Q_2^2 E}{24} = \frac{300^2 \times 0.033013^2 \times 1^2 \times 69 \times 10^3}{24}$$

$$= 358936.786$$

Therefore the equation,

$$f_2^3 + 19.4953f_2^2 = 281995.4292$$

Solving by Newton Raphsan methods

$$f_2 = \{281995.4292 - 19.4953f_2^2\}^{1/3}$$

Starting

$$f_2 = 59.679000$$

$$f_2 = 63.122612$$

$$f_2 = 62.036966$$

$$f_2 = 62.389931$$

$$f_2 = 62.276284$$

$$f_2 = 62.312992$$

$$f_2 = 62.301148$$

$$f_2 = 62.304971$$

Then $T = 62.304971 \times 484.5 \quad N$

$$= 30186.758 \quad N$$

30186.76 N

Note : at 32°C Tension should be less UTS/4.5 =

31311.1 N

Ok

$$Sag = \frac{300^2 \times 0.033013^2 \times 1^2 \times 69 \times 10^3}{8 \times 59.679724}$$

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6.6297 m

6.63 m

SAG at 75°C without wind load

For Equivalent span (m) = 300

$$f_2^2 [f_2 - (f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24f_1^2} - \alpha t E)] = \frac{a^2 \xi^2 Q_2^2 E}{24}$$

$$t = (75 - 15)^\circ C$$

60 °C

$$(f_1 - \frac{a^2 \xi^2 Q_1^2 E}{24f_1^2} - \alpha t E) = \frac{105.2632 - \{300^2 \times 0.033013^2 \times 2.0031^2 \times 69 \times 10^3\}}{24 \times 105.2632^2}$$

$$- 0.0000193 \times 60 \times 69 \times 10^3$$

$$= 105.2632 - 111.286 \quad -85.2$$

$$= -91.2227$$

$$\frac{a^2 \xi^2 Q_2^2 E}{24} = \frac{300^2 \times 0.033013^2 \times 1^2 \times 69 \times 10^3}{24}$$

$$= 358936.786$$

Therefore the equation,

$$f_2^3 + 76.7584 f_2^2 = 281995.4292$$

Solving by Newton Raphsan methods

Starting

$$f_2 = \{281995.4292 - 76.7584f_2^2\}^{1/3}$$
$$f_2 = 47.616234$$
$$f_2 = 52.4523327$$
$$f_2 = 48.5055184$$
$$f_2 = 51.8043689$$
$$f_2 = 49.0987901$$
$$f_2 = 51.3539141$$
$$f_2 = 49.4985096$$
$$f_2 = 51.0419075$$
$$\mathbf{f_2 = 49.7694532}$$

Then

$$T = 49.7694532 \times 484.5 \quad \text{N}$$

$$24113.300 \quad \text{N}$$

$$\mathbf{24113.30 \text{ N}}$$

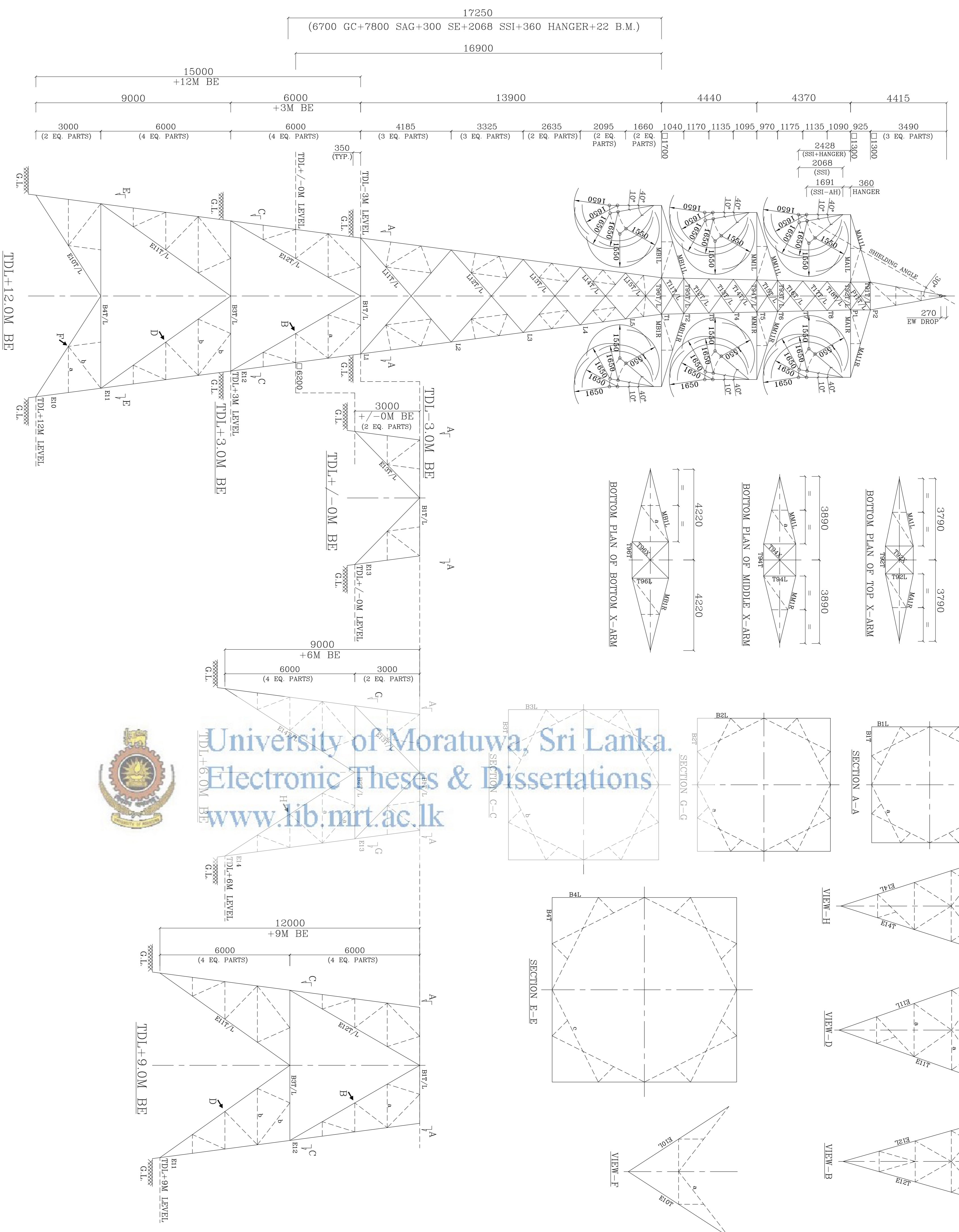
$$\text{Sag} = \frac{300^2 \times 0.03303 \times 1}{8 \times 49.7694532}$$

8.2995 m

8.30 m



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LIST OF DESIGN MEMBERS					LIST OF DESIGN MEMBERS				
Mem. code	Section Selected	Fy	No. of Bolts	No. of Shear	Mem. code	Section Selected	Fy	No. of Bolts	No. of Shear
	mm X mm X mm	mm ²				mm X mm X mm	mm ²		
T95L	L 50 X 50 X 5	275	1		P2	HL 65 X 65 X 6	365	6	6
MB11L	L 55 X 55 X 5	275	2		P1	HL 65 X 65 X 6	365	6	6
MB11R	L 75 X 75 X 6	275	3		P11T	L 45 X 45 X 5	275	1	1
MB1R	L 75 X 75 X 6	275	2		P11L	L 45 X 45 X 5	275	1	1
L5	HL 100 X 100 X 7	355	3		T91T	L 55 X 55 X 5	275	1	1
L6	HL 100 X 100 X 7	355	6		T91L	L 45 X 45 X 5	275	1	1
L15L	L 50 X 50 X 5	275	2		MA11L	L 60 X 60 X 5	275	2	2
L15R	L 50 X 50 X 5	275	2		MA11R	L 70 X 70 X 6	275	2	2
T96T	L 55 X 55 X 5	275	2		MA1R	L 70 X 70 X 6	275	3	3
T96L	L 45 X 45 X 5	275	1		T8	HL 75 X 75 X 6	365	5	5
L4	HL 100 X 100 X 7	355	6		T18T	L 45 X 45 X 5	275	2	2
L14T	L 45 X 45 X 5	275	2		T18L	L 45 X 45 X 5	275	2	2
L14L	L 45 X 45 X 5	275	2		T92T	L 55 X 55 X 5	275	2	2
L3	HL 100 X 100 X 7	355	6		T92L	L 45 X 45 X 5	275	2	2
L13T	L 50 X 50 X 5	275	2		T92X	L 45 X 45 X 5	275	1	1
L2	HL 100 X 100 X 7	355	8		T7	HL 75 X 75 X 6	365	6	6
L12T	L 50 X 50 X 5	275	2		T17T	L 45 X 45 X 5	275	2	2
L12L	HL 100 X 100 X 8	355	6		T17L	HL 75 X 75 X 6	365	6	6
L11T	L 55 X 55 X 5	275	2		T6	HL 75 X 75 X 6	365	6	6
L11L	L 55 X 55 X 5	275	2		T16T	L 45 X 45 X 5	275	2	2
E12	HL 110 X 110 X 8	355	6		T16L	L 45 X 45 X 5	275	2	2
E12T	L 55 X 55 X 5	275	2		T5	HL 75 X 75 X 6	365	6	6
E12L	L 55 X 55 X 5	275	2		T15T	L 45 X 45 X 5	275	2	2
B1T	L 55 X 55 X 5	275	2		T15L	L 45 X 45 X 5	275	2	2
B1L	L 55 X 55 X 5	275	2		T93T	L 45 X 45 X 5	275	1	1
E11	HL 110 X 110 X 8	355	6		MM11L	L 55 X 55 X 5	275	2	2
E11T	L 55 X 55 X 5	275	2		MM11R	L 70 X 70 X 6	275	3	3
E11L	L 55 X 55 X 5	275	2		T4	HL 100 X 100 X 6	365	6	6
B3T	L 55 X 55 X 5	275	2		T14T	L 45 X 50 X 5	275	2	2
B3L	L 55 X 55 X 5	275	2		T14L	L 45 X 45 X 5	275	2	2
E10	HL 110 X 110 X 8	355	6		T94T	L 45 X 45 X 5	275	2	2
E10T	L 65 X 65 X 5	275	2		T94X	L 45 X 45 X 5	275	1	1
E10L	L 65 X 65 X 5	275	2		T3	HL 100 X 100 X 6	365	6	6
B4T	L 60 X 60 X 5	275	2		T13T	L 50 X 50 X 5	275	2	2
B4L	L 60 X 60 X 5	275	2		T13L	L 45 X 45 X 5	275	2	2
E13	HL 110 X 110 X 8	355	6		T2	HL 100 X 100 X 6	365	6	6
E13T	L 60 X 60 X 5	275	2		T12T	L 50 X 50 X 5	275	2	2
E13L	L 60 X 60 X 5	275	2		T12L	L 45 X 45 X 5	275	2	2
E14	HL 110 X 110 X 8	355	6		T1	HL 100 X 100 X 6	365	6	6
E14T	L 55 X 55 X 5	275	2		T11T	L 45 X 45 X 5	275	2	2
E14L	L 55 X 55 X 5	275	2		T11L	L 45 X 45 X 5	275	2	2
B2T	L 55 X 55 X 5	275	2		T95T	L 45 X 45 X 5	275	1	1
B2L	L 55 X 55 X 5	275	2						

REDUNDANT MEMBERS		
SYMBOL	ANGLE SECTION	BOLTS
UNNOTED	L 45X45X5	1
a	L 50X50X5	1
b	L 55X55X5	1
c	L 60X60X5	1



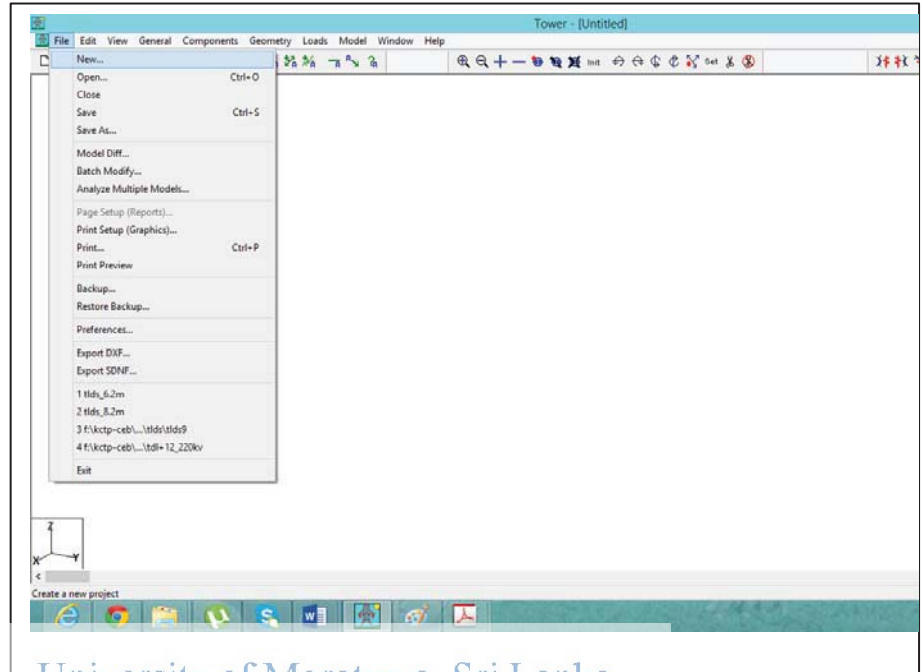
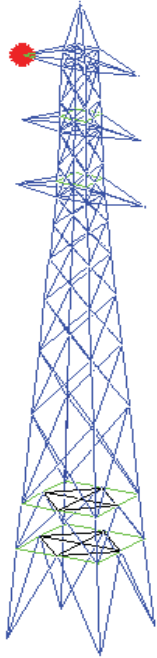
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Appendix F

Modeling & Analysis in PLS - Tower

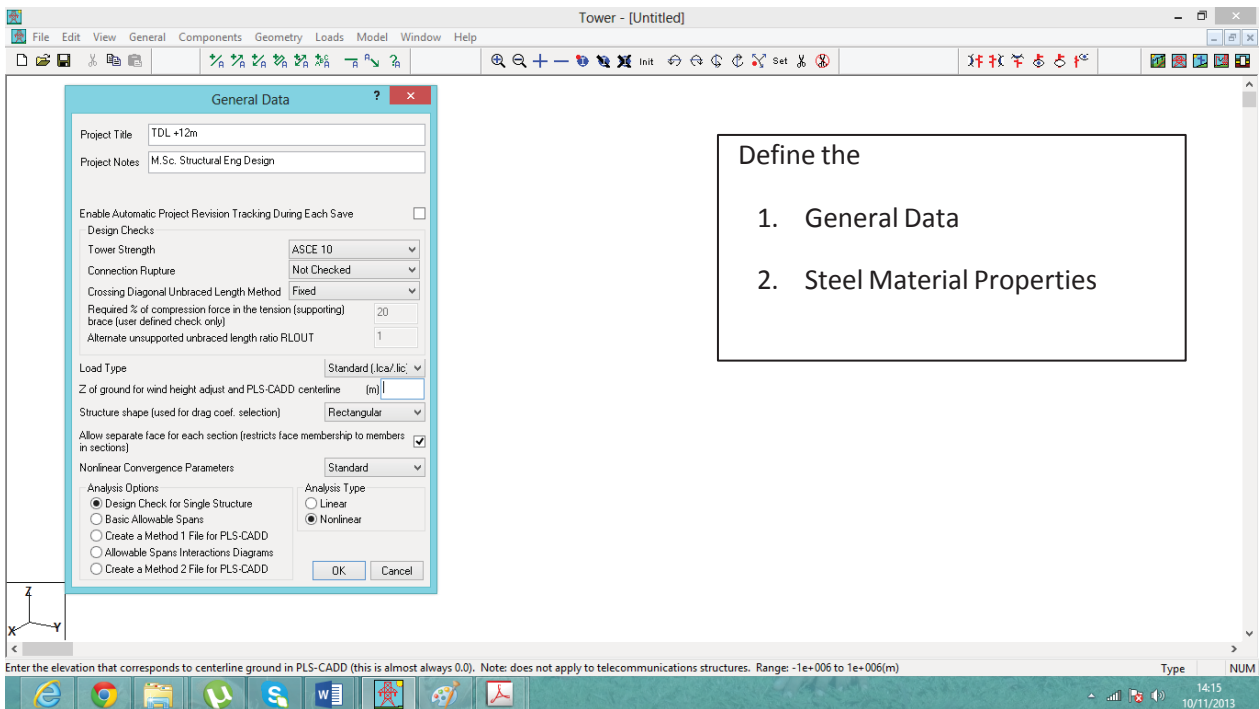
Step by Step instruction and method for modeling and analysis of PLS – Tower

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1. General Data (General>General Data)



2. Steel Material Properties (Component > Steel Material)

LOWER - [tlds_b.r/m]

File Edit View General Components Geometry Loads Model Window Help

Steel Material Properties (From file "F:\kctp-ceb\lot - b kec\tower design\tld\9versin\tlds\tlds9.smp")

A146: PROJECT
MILD STEEL-BSEN:10025-S275JR
HIGH TENSILE STEEL-BSEN:10025-S255JR

	Steel Material Label	Modulus of Elasticity (MPa)	Yield Stress Fy (MPa)	Member All. Stress Hyp. 1 (MPa)	Member All. Stress Hyp. 2 (MPa)	Member Rupture Hyp. 1 (MPa)	Member Rupture Hyp. 2 (MPa)	Member Bearing Hyp. 1 (MPa)
1	MS	199948	275	0	0	0	0	0
2	HT	199948	355	0	0	0	0	0
3								
4								
5								

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3. Define of Angle Properties (Component > Angle.....)

Angle Properties (From file "f:\kctp-ceb\lot - b kec\tower design\tdl\9versin\tdas\tdls9.ang")

Angle Type	Angle Size	Long Leg (cm)	Short Leg (cm)	Thick. (cm)	Unit Weight (N/m)	Gross Area (cm ²)	w/t Ratio	Radius of Gyration Rx (cm)	Radius of Gyration Ry (cm)	Radius of Gyration Rz (cm)	Number of Angles	Wind Width (cm)	Short Edge Dist. (cm)	Long Edge Dist. (cm)	Optimize Cost Factor	Section Modulus (cm ³)
1 SAE	DUMMY	4.5	3	0.03	0.1	0.1	12	1.42	1.42	0.63	1	0	1	1	1	0.7
2 SAE	45*45*5	4.5	4.5	0.5	33.4	4.2763	6.9	1.36	1.36	0.88	1	4.5	2.25	2.25	1	2.5
3 SAE	50*50*5	5	5	0.5	37.3	4.7887	7.8	1.52	1.52	0.98	1	5	2.5	2.5	1	3.1
4 SAE	50*50*6	5	5	0.6	44.2	5.6787	6.34	1.51	1.51	0.97	1	5	2.5	2.5	1	3.7
5 SAE	55*55*5	5.5	5.5	0.5	41.2	5.272	8.7	1.61	1.61	1.07	1	5.5	2.75	2.75	1	3.7
6 SAE	60*60*5	6	6	0.5	45.2	5.7538	9.7	1.83	1.83	1.17	1	6	3	3	1	4.4
7 SAE	60*60*6	6	6	0.6	53	6.8438	7.92	1.82	1.82	1.17	1	6	3	3	1	5.3
8 SAE	75*75*6	7.5	7.5	0.6	66.7	8.6583	10.34	2.3	2.3	1.47	1	7.5	3.75	3.75	1	8.4
9 SAE	90*90*7	9	9	0.7	94.2	12.1353	10.65	2.76	2.76	1.76	1	9	4.5	4.5	1	14.1
10 SAE	100*100*7	10	10	0.7	105	13.5353	12.08	3.08	3.08	1.97	1	10	5	5	1	17.7
11 SAE	100*100*8	10	10	0.8	118.7	15.3853	10.44	3.07	3.07	1.96	1	10	5	5	1	20.1
12 SAE	90*90*6	9	9	0.6	81.4	10.47	12.59	2.77	2.77	1.77	1	9	4.5	4.5	1	12.2
13 SAE	120*120*10	12	12	1	178.5	23.06	10	3.69	3.69	2.36	1	12	6	6	1	36.2
14 SAE	110*110*10	10	10	1	162.8	21.06	9	3.37	3.37	2.15	1	11	5.5	5.5	1	30.1
15 SAE	80*80*6	8	8	0.6	71.6	9.29	11	2.46	2.46	1.57	1	8	4	4	1	9.7
16 SAE	70*70*5	7	7	0.5	53	6.77	11.6	2.15	2.15	1.37	1	7	3.5	3.5	1	6.1
17 SAE	65*65*5	6.5	6.5	0.5	49.1	6.25	10.7	1.99	1.99	1.27	1	6.5	3.25	3.25	1	5.2


Save Save As Merge Report Cancel

Row 7 'SAE' 60*60*6: Number of angles making up a section: 1 for single or round, 2 for double angles, 4 for composite sections with 4 angles

Windows taskbar showing icons for Internet Explorer, Word, PowerPoint, and other applications. System tray shows the date and time as 10/11/2011 14:22.

4. Define the Bolt Properties (Component> Bolt.....)


Bolt Properties (From file "f:\kctp-ceb\ot - b kec\tower design\td\9\versim\tds\tds9.bit")



	Bolt Label	Bolt Diameter (cm)	Hole Diameter (cm)	Ultimate Shear Capacity (kN)	Default End Distance (cm)	Default Bolt Spacing (cm)	Shear Capacity Hyp. 1 (kN)	Shear Capacity Hyp. 2 (kN)
1	M16	1.6	1.75	60	4	0	0	0
2								

5. Define Joints Geometry (Geometry>Primary Joint)

Tower (tds9.2m)



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Joint Label	Symmetry Code	X Coord. (m)	Y Coord. (m)	Z Coord. (m)	X Disp. Rest.	Y Disp. Rest.	Z Disp. Rest.	X Rot. Rest.	Y Rot. Rest.	Z Rot. Rest.
1 A	XY-Symmetry	2.031116389	2.031116389	0	Free	Free	Free	Free	Free	Free
2 B	XY-Symmetry	1	1	14.47	Free	Free	Free	Free	Free	Free
3 C	XY-Symmetry	0.75	0.75	24.32	Free	Free	Free	Free	Free	Free
4 JA	None	0	0	27.47	Free	Free	Free	Free	Free	Free
5 CA	X-Symmetry	0	4.24	14.47	Free	Free	Free	Free	Free	Free
6 CC	X-Symmetry	0	3.937	18.88	Free	Free	Free	Free	Free	Free
7 CE	X-Symmetry	0	3.85	23.24	Free	Free	Free	Free	Free	Free

6. Define Joints Geometry (Geometry>Secondary Joint)

Secondary Joints

Joint Label	Symmetry Code	Origin Joint	End Joint	Fraction	Elevation	X Disp. Rest.	Y Disp. Rest.	Z Disp. Rest.	X Rot. Rest.	Y Rot. Rest.	Z Rot. Rest.
1 B1	XY-Symmetry	AP	BP	0	4.7	Free	Free	Free	Free	Free	Free
2 B2	XY-Symmetry	AP	BP	0	7.6	Free	Free	Free	Free	Free	Free
3 B3	XY-Symmetry	AP	BP	0	10.385	Free	Free	Free	Free	Free	Free
4 B4	XY-Symmetry	AP	BP	0	12.825	Free	Free	Free	Free	Free	Free
5 C1	XY-Symmetry	BP	CP	0	15.533	Free	Free	Free	Free	Free	Free
6 C2	XY-Symmetry	BP	CP	0	16.34	Free	Free	Free	Free	Free	Free
7 C3	XY-Symmetry	BP	CP	0	18.33	Free	Free	Free	Free	Free	Free
8 C4	XY-Symmetry	BP	CP	0	19.894	Free	Free	Free	Free	Free	Free
9 C5	XY-Symmetry	BP	CP	0	20.37	Free	Free	Free	Free	Free	Free
10 C6	XY-Symmetry	BP	CP	0	23.24	Free	Free	Free	Free	Free	Free
11 C1SF0.50	X-Symmetry	C1S	C1Y	0.5	0	Free	Free	Free	Free	Free	Free
12 C1YF0.50	Y-Symmetry	C1Y	C1XY	0.5	0	Free	Free	Free	Free	Free	Free
13 C4SF0.50	X-Symmetry	C4S	C4Y	0.5	0	Free	Free	Free	Free	Free	Free
14 C4YF0.50	Y-Symmetry	C4Y	C4XY	0.5	0	Free	Free	Free	Free	Free	Free
15 X1	XY-Symmetry	AP	BP	0	-6	Free	Free	Free	Free	Free	Free
16 X2	XY-Symmetry	AP	BP	0	-9	Free	Free	Free	Free	Free	Free
17 X3	XY-Symmetry	AP	BP	0	-15	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
18 X1XF0.50	Y-Symmetry	X1X	X1S	0.5	0	Free	Free	Free	Free	Free	Free
19 X1SF0.50	X-Symmetry	X1S	X1Y	0.5	0	Free	Free	Free	Free	Free	Free
20 X2XF0.50	Y-Symmetry	X2X	X2S	0.5	0	Free	Free	Free	Free	Free	Free
21 X2SF0.50	X-Symmetry	X2S	X2Y	0.5	0	Free	Free	Free	Free	Free	Free
22											
23											

OK Cancel

Click here to select column and show table popup menu.

Type

7. Define Angle Group (Geometry>Angle Group..)

Angle Groups

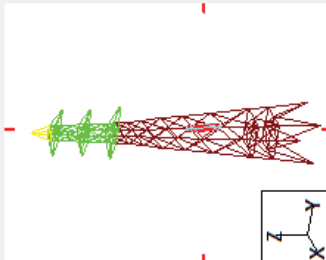
	Group Label	Group Description	Angle Type	Angle Size	Material Type	Element Type	Group Type	Optimize Group	Allow. Angle Wic For Optim (cm)
1	M1		SAE	100*100*8	HT	Leg	Leg	Size + Type	10.000
2	M2		SAE	100*100*7	HT	Truss	Leg	Size + Type	10.000
3	M3		SAE	90*90*7	HT	Truss	Leg	Size + Type	10.000
4	M4		SAE	90*90*7	HT	Truss	Leg	Size + Type	10.000
5	M5		SAE	90*90*6	HT	Truss	Leg	Size + Type	10.000
6	M6		SAE	75*75*6	HT	Truss	Leg	Size + Type	10.000
7	M7		SAE	60*60*6	HT	Truss	Leg	Size + Type	10.000
8	D1		SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
9	D2		SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
10	D5		SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
11	D6		SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
12	D9		SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
13	D10		SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
14	D11		SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
15	D12		SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
16	D13		SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
17	D14		SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
18	D15		SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
19	D16		SAE	45*45*5	MS	Truss	Other	Size + Type	10.000
20	D17		SAE	45*45*5	MS	Truss	Other	Size + Type	10.000
21	D18		SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000
22	D19		SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000

OK Cancel

Click here to select column and show table popup menu.

8. Define Angle Member


Angle Member Connectivity



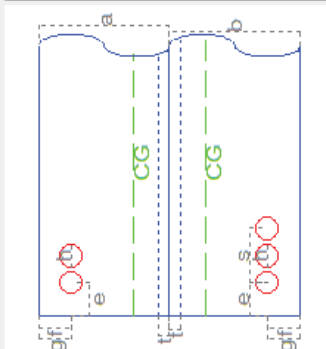
Angle 'M1P'
 Group: M1
 RI
 SAE 100-100+8
 Dimensions (cm)
 a = 10.0000
 b = 10.0000
 c = 0.8000
 M16
 nb = 5
 rh = 2.0000
 d = 1.6000
 h = 1.7500
 e = 2.5000
 s = 4.0000
 f = 2.5000
 g = 2.5000
 Capacities (kN)

Model Check Report

No errors or relevant warnings detected.

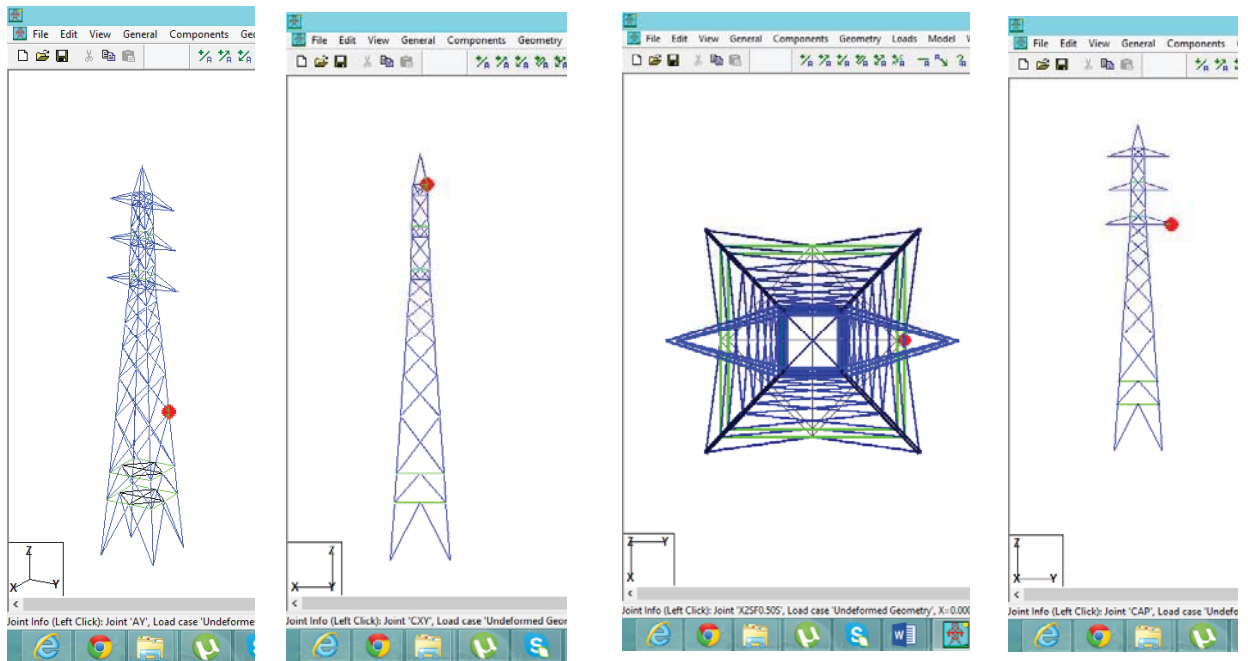


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Member Label	Group Label	Section Label	Symmetry Code	Origin Joint	End Joint	Ecc. Code	Rest. Code	Ratio RLY	Ratio RLZ	Bolt Type	# Bolts	# Bolt Holes	# Shear Planes	Connect Leg	Short Edge Dist. (cm)	Long Edge Dist. (cm)	End Dist. (cm)	Bolt Spaci. (cm)
1	M1	S1	XY-Symmetry	AP	B1S	1	4	0.25	0.25	M16	5	2	2	Both	2.5	2.5	0	0
2	M2	S1	XY-Symmetry	B1S	B2S	1	4	0.25	0.25	M16	7	2	1	Both	2.5	2.5	0	0
3	M3	S1	XY-Symmetry	B2S	B3S	1	4	0.33	0.33	M16	6	2	2	Both	2.5	2.5	0	0
4	M4	S1	XY-Symmetry	B3S	B4S	1	4	0.5	0.5	M16	6	2	2	Both	2.5	2.5	0	0
5	M5	S1	XY-Symmetry	B4S	BP	1	4	0.5	0.5	M16	6	2	2	Both	2.5	2.5	0	0
6	M6	S2	XY-Symmetry	BP	C1S	1	4	0.5	0.5	M16	4	2	1	Both	2.5	2.5	0	0
7	M61	S2	XY-Symmetry	C1S	C2S	1	4	1	1	M16	4	2	1	Both	2.5	2.5	0	0
8	M62	S2	XY-Symmetry	C2S	C3S	1	4	0.5	0.5	M16	4	2	1	Both	2.5	2.5	0	0
9	M7	S2	XY-Symmetry	C3S	C4S	1	4	1	1	M16	4	2	1	Both	2.5	2.5	0	0
10	M71	S2	XY-Symmetry	C4S	C5S	1	4	1	1	M16	4	2	1	Both	2.5	2.5	0	0
11	M72	S2	XY-Symmetry	C5S	C6S	1	4	0.5	0.5	M16	4	2	1	Both	2.5	2.5	0	0
12	M73	S2	XY-Symmetry	C6S	CP	1	4	1	1	M16	4	2	1	Both	2.5	2.5	0	0

9. Model View



Isometric View

View from Left /Right

View from Top

View from Front



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10. Define the Load Cases (Load>Vector Load(LCA File)...) ?

Vector Load Cases - [f:\kctp-ceb\lot - b kec\tower design\tdl\9versin\tdls\tdls9.lca]

Wind loads on insulators and insulator weights included in Point Loads

Edit Loading Method Parameters Note that SF stands for Strength Factor, NDT Safety Factor

Load Case Description	Dead Load Factor	Wind Area Factor	SF for Steel Poles and Towers	SF for Wood Poles	SF for Conc. Uit.	SF for Conc. First Crack	SF for Conc. Zero Tens.	SF for GAVS, Non Cable Arms	SF for Braces	SF for Insuls.	SF for Found.	Point Loads	Wind/Ice Model	Trans. Wind Pressure (Pa)	Longit. Wind Pressure (Pa)	Ice Thick. (cm)
1 b001-NCMX	2	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
2 b002-NCMN	2	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
3 b003-PKMX	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
4 b004-PKMN	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
5 b005-1LMX	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
6 b006-1LMN	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
7 b007-2LMX	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
8 b008-2LMN	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
9 b009-3LMX	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
10 b010-3LMN	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
11 b011-1RMX	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
12 b012-1RMN	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
13 b013-2RMX	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
14 b014-2R MN	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
15 b015-3RMX	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
16 b016-3RMN	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
17 b017-NCLSMX	2	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
18 b018-NCLSMN	2	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000
19 b019-PKLSMX	1.25	1	1	1	1	0	0	1	1	1	1	Edit (15)	Wind on Face	0	0	0.000

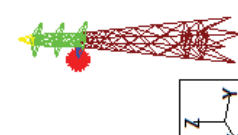
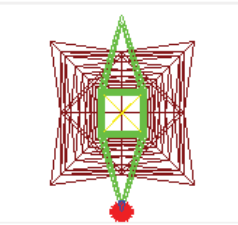
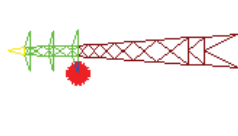
Row 15 'b015-3RMX': Strength factor to be used for insulators: 0 will prevent this component from being checked, 0.5 will have its strength Range: 0 to 3.4e+038

Save Save As Merge Cancel

14: 10/11


11. Point Load

Point Loads - [b001-NCMX]

Model Check Report

No errors or relevant warnings detected.



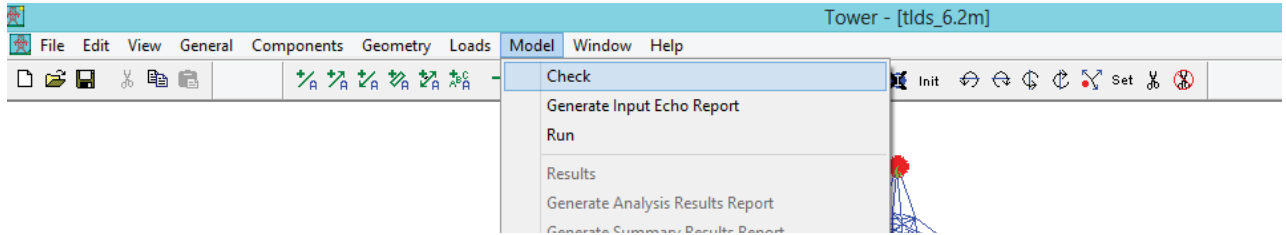
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Joint Label	Vertical Load (N)	Transverse Load (N)	Longitudinal Load (N)	Load Comment
1 AP	0	8784	0	AP
2 AX	0	8784	0	AX
3 AY	0	8784	0	AY
4 AXY	0	8784	0	AXY
5 CAX	23670	30941	0	CAX
6 CAP	23670	30941	0	CAP
7 CCX	23670	25348	0	CCX
8 CCP	23670	25348	0	CCP
9 CEX	23670	24420	0	CEX
10 CEP	23670	24420	0	CEP
11 JAP	9200	10197	0	JAP
12 X2S	0	6375	0	X2S
13 X2X	0	6375	0	X2X
14 X2Y	0	6375	0	X2Y
15 X2XY	0	6375	0	X2XY

Row 14 'X2Y': Longitudinal is along the X axis (positive coming out of the screen)

Section 15: 10/11

12. Check the Model (Model>check)



Results:

Tower Version 9.20 14:36:10 10 November 2013

Check of model "132 kv D/C tower type TDLS"

Checking 19 Joints
Checking 1 Bolt properties
Checking 276 Angle elements
Checking 64 Angle groups
Checking 3 Equipment properties
Checking load case "b001-NCMX"
Checking 15 concentrated loads
Checking load case "b002-NCMN"
Checking 15 concentrated loads
Checking load case "b003-PKMX"
Checking 15 concentrated loads
Checking load case "b004-PKMN"
Checking 15 concentrated loads
Checking load case "b005-1LMX"
Checking 15 concentrated loads
Checking load case "b006-1LMN"
Checking 15 concentrated loads
Checking load case "b007-2LMX"
Checking 15 concentrated loads
Checking load case "b008-2LMN"
Checking 15 concentrated loads
Checking load case "b009-3LMX"
Checking 15 concentrated loads
Checking load case "b010-3LMN"
Checking 15 concentrated loads
Checking load case "b011-1RMX"
Checking 15 concentrated loads
Checking load case "b012-1RMN"
Checking 15 concentrated loads
Checking load case "b013-2RMX"
Checking 15 concentrated loads
Checking load case "b014-2R MN"
Checking 15 concentrated loads
Checking load case "b015-3RMX"
Checking 15 concentrated loads
Checking load case "b016-3RMN"
Checking 15 concentrated loads
Checking load case "b017-NCLSMX"
Checking 15 concentrated loads
Checking load case "b018-NCLSMN"
Checking 15 concentrated loads
Checking load case "b019-PKLSMX"
Checking 15 concentrated loads
Checking load case "b020-PKLSMN"
Checking 15 concentrated loads

Checking load case "b021-1LLSMX"
Checking 15 concentrated loads
Checking load case "b022-1LLSMN"
Checking 15 concentrated loads
Checking load case "b023-2LLSMX"
Checking 15 concentrated loads
Checking load case "b024-2LLSMN"
Checking 15 concentrated loads
Checking load case "b025-3LLSMX"
Checking 15 concentrated loads
Checking load case "b026-3LLSMN"
Checking 15 concentrated loads
Checking load case "b027-NCRSMX"
Checking 15 concentrated loads
Checking load case "b028-NCRSMN"
Checking 15 concentrated loads
Checking load case "b029-PKRSMX"
Checking 15 concentrated loads
Checking load case "b030-PKRSMN"
Checking 15 concentrated loads
Checking load case "b031-1RRSMX"
Checking 15 concentrated loads
Checking load case "b032-1RRSMN"
Checking 15 concentrated loads
Checking load case "b033-2RRSMX"
Checking 15 concentrated loads
Checking load case "b034-2RRSMN"
Checking 15 concentrated loads
Checking load case "b035-3RRSMX"
Checking 15 concentrated loads
Checking load case "b036-3RRSMN"
Checking 15 concentrated loads
Checking 68 Secondary Joints
Checking 3 sections

Checking 1 Clamp properties
Checking 15 Clamp insulators
Checking 15 PLS-CADD links
Total of 0 errors detected while checking

Checking if a model for analysis can be built...
Model built successfully.

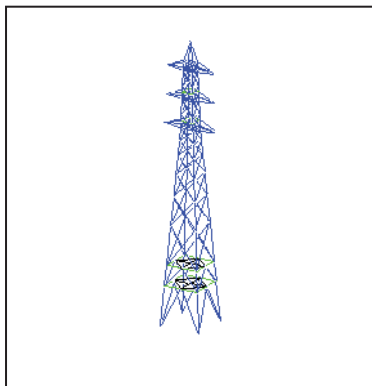
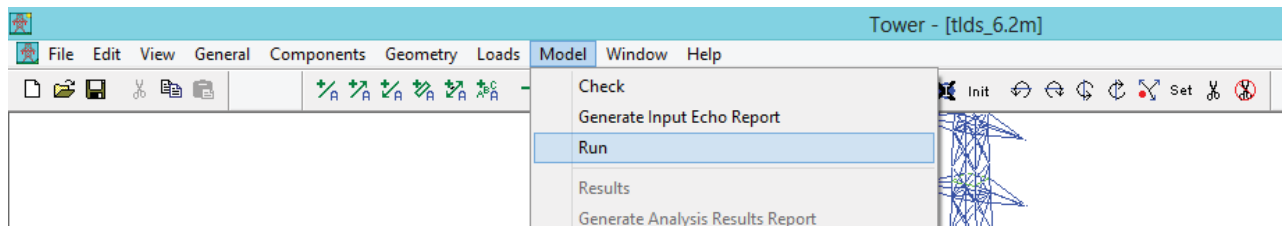
Checking view...

Joint Errors report: (Joint errors shown in red in current geometry view)
0 Errors detected

Joint Warnings report: (Joint warnings shown in green in current geometry view)
0 Warnings detected

Member Warnings report: (Member warnings shown in green in current geometry view)
0 Warnings detected

13. Analysis the Model (Model> Run)



Joints Geometry:

Joint Label	Symmetry Code	X Coord. (m)	Y Coord. (m)	Z Coord. (m)	X Disp. Rest.	Y Disp. Rest.	Z Disp. Rest.	X Rot. Rest.	Y Rot. Rest.	Z Rot. Rest.
AP	XY-Symmetry	2.031	2.031	0	Free	Free	Free	Free	Free	Free
BP	XY-Symmetry	1	1	14.47	Free	Free	Free	Free	Free	Free
CP	XY-Symmetry	0.75	0.75	24.32	Free	Free	Free	Free	Free	Free
JAP	None	0	0	27.47	Free	Free	Free	Free	Free	Free
CAP	X-Symmetry	0	4.21	14.47	Free	Free	Free	Free	Free	Free
CCP	X-Symmetry	0	3.937	18.88	Free	Free	Free	Free	Free	Free
CEP	X-Symmetry	0	3.85	23.24	Free	Free	Free	Free	Free	Free
AX	X-GenXY	2.031	-2.031	0	Free	Free	Free	Free	Free	Free
AXY	XY-GenXY	-2.031	-2.031	0	Free	Free	Free	Free	Free	Free
AY	Y-GenXY	-2.031	2.031	0	Free	Free	Free	Free	Free	Free
BX	X-GenXY	1	-1	14.47	Free	Free	Free	Free	Free	Free
BXY	XY-GenXY	-1	-1	14.47	Free	Free	Free	Free	Free	Free
BY	Y-GenXY	-1	1	14.47	Free	Free	Free	Free	Free	Free
CX	X-GenXY	0.75	-0.75	24.32	Free	Free	Free	Free	Free	Free
CXY	XY-GenXY	-0.75	-0.75	24.32	Free	Free	Free	Free	Free	Free
CY	Y-GenXY	-0.75	0.75	24.32	Free	Free	Free	Free	Free	Free
CAX	X-Gen	0	-4.21	14.47	Free	Free	Free	Free	Free	Free
CX	X-Gen	0	-3.937	18.88	Free	Free	Free	Free	Free	Free
CEX	X-Gen	0	-3.85	23.24	Free	Free	Free	Free	Free	Free

Secondary Joints:

Joint Label	Symmetry Code	Origin Joint	End Joint	Fraction	Elevation (m)	X Disp. Rest.	Y Disp. Rest.	Z Disp. Rest.	X Rot. Rest.	Y Rot. Rest.	Z Rot. Rest.
B1S	XY-Symmetry	AP	BP	0	4.21	Free	Free	Free	Free	Free	Free
B2S	XY-Symmetry	AP	BP	0	7.61	Free	Free	Free	Free	Free	Free
B3S	XY-Symmetry	AP	BP	0	10.39	Free	Free	Free	Free	Free	Free
B4S	XY-Symmetry	AP	BP	0	12.63	Free	Free	Free	Free	Free	Free
C1S	XY-Symmetry	BP	CP	0	15.53	Free	Free	Free	Free	Free	Free
C2S	XY-Symmetry	BP	CP	0	16.54	Free	Free	Free	Free	Free	Free
C3S	XY-Symmetry	BP	CP	0	18.88	Free	Free	Free	Free	Free	Free
C4S	XY-Symmetry	BP	CP	0	19.89	Free	Free	Free	Free	Free	Free
C5S	XY-Symmetry	BP	CP	0	20.87	Free	Free	Free	Free	Free	Free
C6S	XY-Symmetry	BP	CP	0	23.24	Free	Free	Free	Free	Free	Free
C1SF0.50S	X-Symmetry	C1S	C1Y	0.5	0	Free	Free	Free	Free	Free	Free
C1YF0.50S	Y-Symmetry	C1Y	C1XY	0.5	0	Free	Free	Free	Free	Free	Free
C4SF0.50S	X-Symmetry	C4S	C4Y	0.5	0	Free	Free	Free	Free	Free	Free
C4YF0.50S	Y-Symmetry	C4Y	C4XY	0.5	0	Free	Free	Free	Free	Free	Free
X1S	XY-Symmetry	AP	BP	0	-6	Free	Free	Free	Free	Free	Free
X2S	XY-Symmetry	AP	BP	0	-9	Free	Free	Free	Free	Free	Free
X3S	XY-Symmetry	AP	BP	0	-15	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
X1XF0.50S	Y-Symmetry	X1X	X1S	0.5	0	Free	Free	Free	Free	Free	Free
X1SF0.50S	X-Symmetry	X1S	X1Y	0.5	0	Free	Free	Free	Free	Free	Free
X2XF0.50S	Y-Symmetry	X2X	X2S	0.5	0	Free	Free	Free	Free	Free	Free
X2SF0.50S	X-Symmetry	X2S	X2Y	0.5	0	Free	Free	Free	Free	Free	Free
B1X	X-GenXY	AP	BP	0	4.21	Free	Free	Free	Free	Free	Free
B1XY	XY-GenXY	AP	BP	0	4.21	Free	Free	Free	Free	Free	Free
B1Y	Y-GenXY	AP	BP	0	4.21	Free	Free	Free	Free	Free	Free

Secondary Joints:

Joint Label	Symmetry Code	Origin Joint	End Joint	Fraction	Elevation	X Disp. Rest.	Y Disp. Rest.	Z Disp. Rest.	X Rot. Rest.	Y Rot. Rest.	Z Rot. Rest.
B2X	X-GenXY	AP	BP	0	7.61	Free	Free	Free	Free	Free	Free
B2XY	XY-GenXY	AP	BP	0	7.61	Free	Free	Free	Free	Free	Free
B2Y	Y-GenXY	AP	BP	0	7.61	Free	Free	Free	Free	Free	Free
B3X	X-GenXY	AP	BP	0	10.39	Free	Free	Free	Free	Free	Free
B3XY	XY-GenXY	AP	BP	0	10.39	Free	Free	Free	Free	Free	Free
B3Y	Y-GenXY	AP	BP	0	10.39	Free	Free	Free	Free	Free	Free
B4X	X-GenXY	AP	BP	0	12.63	Free	Free	Free	Free	Free	Free
B4XY	XY-GenXY	AP	BP	0	12.63	Free	Free	Free	Free	Free	Free
B4Y	Y-GenXY	AP	BP	0	12.63	Free	Free	Free	Free	Free	Free
C1X	X-GenXY	BP	CP	0	15.53	Free	Free	Free	Free	Free	Free
C1XY	XY-GenXY	BP	CP	0	15.53	Free	Free	Free	Free	Free	Free
C1Y	Y-GenXY	BP	CP	0	15.53	Free	Free	Free	Free	Free	Free
C2X	X-GenXY	BP	CP	0	16.54	Free	Free	Free	Free	Free	Free
C2XY	XY-GenXY	BP	CP	0	16.54	Free	Free	Free	Free	Free	Free
C2Y	Y-GenXY	BP	CP	0	16.54	Free	Free	Free	Free	Free	Free
C3X	X-GenXY	BP	CP	0	18.88	Free	Free	Free	Free	Free	Free

Joint Label	Symmetry Code	Origin Joint	End Joint	Fraction	Elevation	X Disp. Rest.	Y Disp. Rest.	Z Disp. Rest.	X Rot. Rest.	Y Rot. Rest.	Z Rot. Rest.
C3XY	XY-GenXY	BP	CP	0	18.88	Free	Free	Free	Free	Free	Free
C3Y	Y-GenXY	BP	CP	0	18.88	Free	Free	Free	Free	Free	Free
C4X	X-GenXY	BP	CP	0	19.89	Free	Free	Free	Free	Free	Free
C4XY	XY-GenXY	BP	CP	0	19.89	Free	Free	Free	Free	Free	Free
C4Y	Y-GenXY	BP	CP	0	19.89	Free	Free	Free	Free	Free	Free
C5X	X-GenXY	BP	CP	0	20.87	Free	Free	Free	Free	Free	Free
C5XY	XY-GenXY	BP	CP	0	20.87	Free	Free	Free	Free	Free	Free
C5Y	Y-GenXY	BP	CP	0	20.87	Free	Free	Free	Free	Free	Free
C6X	X-GenXY	BP	CP	0	23.24	Free	Free	Free	Free	Free	Free
C6XY	XY-GenXY	BP	CP	0	23.24	Free	Free	Free	Free	Free	Free
C6Y	Y-GenXY	BP	CP	0	23.24	Free	Free	Free	Free	Free	Free
C1SF0.50X	X-Gen	C1S	C1Y	0.5	0	Free	Free	Free	Free	Free	Free
C1YF0.50Y	Y-Gen	C1Y	C1XY	0.5	0	Free	Free	Free	Free	Free	Free
C4SF0.50X	X-Gen	C4S	C4Y	0.5	0	Free	Free	Free	Free	Free	Free
C4YF0.50Y	Y-Gen	C4Y	C4XY	0.5	0	Free	Free	Free	Free	Free	Free
X1X	X-GenXY	AP	BP	0	-6	Free	Free	Free	Free	Free	Free
X1XY	XY-GenXY	AP	BP	0	-6	Free	Free	Free	Free	Free	Free
X1Y	Y-GenXY	AP	BP	0	-6	Free	Free	Free	Free	Free	Free
X2X	X-GenXY	AP	BP	0	-9	Free	Free	Free	Free	Free	Free
X2XY	XY-GenXY	AP	BP	0	-9	Free	Free	Free	Free	Free	Free
X2Y	Y-GenXY	AP	BP	0	-9	Free	Free	Free	Free	Free	Free
X3X	X-GenXY	AP	BP	0	-15	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
X3XY	XY-GenXY	AP	BP	0	-15	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
X3Y	Y-GenXY	AP	BP	0	-15	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
X1XF0.50Y	Y-Gen	X1X	X1S	0.5	0	Free	Free	Free	Free	Free	Free
X1SF0.50X	X-Gen	X1S	X1Y	0.5	0	Free	Free	Free	Free	Free	Free
X2XF0.50Y	Y-Gen	X2X	X2S	0.5	0	Free	Free	Free	Free	Free	Free
X2SF0.50X	X-Gen	X2S	X2Y	0.5	0	Free	Free	Free	Free	Free	Free

Angle Groups:

Group Label	Group Description	Angle Type	Material Size	Material Type	Element Type	Group Type	Optimize Group	Allow. Angle	Add. Width For Optimize
M1	M1	SAE	100*100*8	HT	Truss	Leg	Size + Type	10.000	
M2	M2	SAE	100*100*7	HT	Truss	Leg	Size + Type	10.000	
M3	M3	SAE	90*90*7	HT	Truss	Leg	Size + Type	10.000	
M4	M4	SAE	90*90*7	HT	Truss	Leg	Size + Type	10.000	
M5	M5	SAE	90*90*6	HT	Truss	Leg	Size + Type	10.000	
M6	M6	SAE	75*75*6	HT	Truss	Leg	Size + Type	10.000	
M7	M7	SAE	60*60*6	HT	Truss	Leg	Size + Type	10.000	
D1	D1	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D2	D2	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D5	D5	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D6	D6	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D9	D9	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D10	D10	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D11	D11	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D12	D12	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D13	D13	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D14	D14	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D15	D15	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D16	D16	SAE	45*45*5	MS	Truss	Other	Size + Type	10.000	
D17	D17	SAE	45*45*5	MS	Truss	Other	Size + Type	10.000	
D18	D18	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D19	D19	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D20	D20	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D21	D21	SAE	45*45*5	MS	Truss	Other	Size + Type	10.000	
D22	D22	SAE	45*45*5	MS	Truss	Other	Size + Type	10.000	

Angle Groups:

Group Label	Group Description	Angle Type	Angle Size	Material Type	Element Type	Group Type	Optimize Group	Allow. Angle For Optimize	Add. Width (cm)
D23	D23	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D24	D24	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D25	D25	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D26	D26	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D27	D27	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D28	D28	SAE	45*45*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D30	D30	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D31	D31	SAE	50*50*5	MS	Truss	Crossing Diagonal	Size + Type	10.000	
D38	D38	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
D39	D39	SAE	45*45*5	MS	Truss	Other	Size + Type	10.000	
D42	D42	SAE	60*60*5	MS	Truss	Other	Size + Type	10.000	
D43	D43	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
H1	H1	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
H2	H2	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
H3	H3	SAE	45*45*5	MS	Beam	Other	Size + Type	10.000	
H4	H4	SAE	45*45*5	MS	Beam	Other	Size + Type	10.000	
H5	H5	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
H6	H6	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
H7	H7	SAE	45*45*5	MS	Beam	Other	Size + Type	10.000	
H8	H8	SAE	45*45*5	MS	Beam	Other	Size + Type	10.000	
H9	H9	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
H10	H10	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	

Group Label	Group Description	Angle Type	Angle Size	Material Type	Element Type	Group Type	Optimize Group	Allow. Angle For Optimize	Add. Width (cm)
H11	H11	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
H12	H12	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
H13	H13	SAE	60*60*5	MS	Beam	Other	Size + Type	10.000	
H14	H14	SAE	60*60*5	MS	Beam	Other	Size + Type	10.000	
H17	H17	SAE	60*60*5	MS	Beam	Other	Size + Type	10.000	
H18	H18	SAE	60*60*5	MS	Beam	Other	Size + Type	10.000	
B1	B1	SAE	75*75*6	MS	Truss	Other	Size + Type	10.000	
B2	B2	SAE	70*70*6	MS	Truss	Other	Size + Type	10.000	
B3	B3	SAE	60*60*6	HT	Truss	Other	Size + Type	10.000	
T1	T1	SAE	50*50*5	MS	Truss	Other	Size + Type	10.000	
T2	T2	SAE	45*45*5	MS	Truss	Other	Size + Type	10.000	
T3	T3	SAE	45*45*5	MS	Truss	Other	Size + Type	10.000	
P1	P1	SAE	50*50*6	MS	Truss	Other	Size + Type	10.000	
M8	M8	SAE	120*120*8	HT	Truss	Leg	Size + Type	10.000	
M10	M10	SAE	100*100*8	HT	Truss	Leg	Size + Type	10.000	
M12	M12	SAE	100*100*10	HT	Truss	Leg	Size + Type	10.000	
DUMM	DUMM	SAE	DUMMY	MS		Fictitious	Size + Type	10.000	

Appendix G

Successfully performed linear analysis

Member check option: ASCE 10
 Connection rupture check: Not Checked
 Crossing diagonal check: Fixed

Loads from file: d:\msc ei\msc research project\pls tower design\tower design\tacsr _as \tdl.lca

*** Analysis Results:

Maximum element usage is 93.48% for Angle "H10Y" in load case "b009-3LMX"
 Maximum insulator usage is 5.06% for Clamp "CA0" in load case "b005-1LMX"

Summary of Joint Support Reactions For All Load Cases:

Load Case	Joint Label	Long. Force (kN)	Tran. Force (kN)	Vert. Force (kN)	Shear Force (kN)	Tran. Moment (kN-m)	Long. Moment (kN-m)	Vert. Moment (kN-m)	Bending Moment (kN-m)	Found. Usage %
b001-NCMX	X3S	-50.20	-62.66	386.39	80.29	-0.00	-0.00	-0.00	0.00	0.00
b001-NCMX	X3X	35.93	-48.35	-277.79	60.24	-0.00	-0.00	-0.00	0.00	0.00
b001-NCMX	X3XY	-36.25	-50.46	-282.38	62.13	-0.00	-0.00	-0.00	0.00	0.00
b001-NCMX	X3Y	50.52	-64.77	390.99	82.14	-0.00	-0.00	-0.00	0.00	0.00
b002-NCMN	X3S	-49.38	-63.64	380.54	80.55	-0.00	-0.00	-0.00	0.00	0.00
b002-NCMN	X3X	38.28	-52.48	-297.59	64.96	-0.00	-0.00	-0.00	0.00	0.00
b002-NCMN	X3XY	-38.28	-52.48	-297.59	64.96	-0.00	-0.00	-0.00	0.00	0.00
b002-NCMN	X3Y	49.38	-63.64	380.54	80.55	-0.00	-0.00	-0.00	0.00	0.00
b003-PKMX	X3S	-38.99	-48.90	308.10	62.55	-0.00	-0.00	-0.00	0.00	0.00
b003-PKMX	X3X	15.02	-22.99	-109.71	27.46	-0.00	-0.00	-0.00	0.00	0.00
b003-PKMX	X3XY	-28.44	-38.32	-228.32	47.73	-0.00	-0.00	-0.00	0.00	0.00
b003-PKMX	X3Y	25.56	-33.57	189.49	42.20	-0.00	-0.00	-0.00	0.00	0.00
b004PKMN	X3S	-36.75	-46.60	290.26	59.34	-0.00	-0.00	-0.00	0.00	0.00
b004PKMN	X3X	17.26	-25.30	-127.54	30.62	-0.00	-0.00	-0.00	0.00	0.00
b004PKMN	X3XY	-29.83	-39.64	-238.53	49.61	-0.00	-0.00	-0.00	0.00	0.00
b004PKMN	X3Y	24.18	-32.25	179.27	40.31	-0.00	-0.00	-0.00	0.00	0.00
b005-1LMX	X3S	-38.69	-55.16	318.90	67.37	-0.00	-0.00	-0.00	0.00	0.00
b005-1LMX	X3X	5.11	-26.36	-98.17	26.85	-0.00	-0.00	-0.00	0.00	0.00
b005-1LMX	X3XY	-38.20	-34.21	-238.67	51.28	-0.00	-0.00	-0.00	0.00	0.00
b005-1LMX	X3Y	25.45	-26.30	175.44	36.60	-0.00	-0.00	-0.00	0.00	0.00
b006-1LMN	X3S	-36.86	-53.40	304.76	64.88	-0.00	-0.00	-0.00	0.00	0.00
b006-1LMN	X3X	6.81	-28.12	-111.31	28.93	-0.00	-0.00	-0.00	0.00	0.00
b006-1LMN	X3XY	-39.90	-35.97	-251.81	53.72	-0.00	-0.00	-0.00	0.00	0.00
b006-1LMN	X3Y	23.62	-24.54	161.31	34.06	-0.00	-0.00	-0.00	0.00	0.00
b007-2LMX	X3S	-38.98	-56.19	328.72	68.38	-0.00	-0.00	-0.00	0.00	0.00
b007-2LMX	X3X	5.39	-24.64	-86.74	25.22	-0.00	-0.00	-0.00	0.00	0.00
b007-2LMX	X3XY	-37.71	-35.93	-248.57	52.09	-0.00	-0.00	-0.00	0.00	0.00
b007-2LMX	X3Y	24.96	-25.27	164.10	35.52	-0.00	-0.00	-0.00	0.00	0.00
b008-2LMN	X3S	-37.15	-54.42	314.62	65.90	-0.00	-0.00	-0.00	0.00	0.00
b008-2LMN	X3X	7.10	-26.40	-99.92	27.34	-0.00	-0.00	-0.00	0.00	0.00
b008-2LMN	X3XY	-39.42	-37.69	-261.75	54.54	-0.00	-0.00	-0.00	0.00	0.00
b008-2LMN	X3Y	23.14	-23.51	150.00	32.99	-0.00	-0.00	-0.00	0.00	0.00

b009-3LMX	X3S	-39.03	-57.49	338.72	69.48	-0.00	-0.00	-0.00	0.00	0.00
b009-3LMX	X3X	5.45	-23.22	-75.74	23.86	-0.00	-0.00	-0.00	0.00	0.00
b009-3LMX	X3XY	-37.47	-37.34	-258.12	52.90	-0.00	-0.00	-0.00	0.00	0.00
b009-3LMX	X3Y	24.72	-23.98	152.65	34.44	-0.00	-0.00	-0.00	0.00	0.00
b010-3LMN	X3S	-37.21	-55.72	324.62	67.00	-0.00	-0.00	-0.00	0.00	0.00
b010-3LMN	X3X	7.16	-24.99	-88.93	25.99	-0.00	-0.00	-0.00	0.00	0.00
b010-3LMN	X3XY	-39.18	-39.11	-271.31	55.35	-0.00	-0.00	-0.00	0.00	0.00
b010-3LMN	X3Y	22.90	-22.21	138.56	31.90	-0.00	-0.00	-0.00	0.00	0.00
b011-1RMX	X3S	-48.44	-44.66	316.10	65.89	-0.00	-0.00	-0.00	0.00	0.00
b011-1RMX	X3X	14.86	-15.86	-95.37	21.73	-0.00	-0.00	-0.00	0.00	0.00
b011-1RMX	X3XY	-28.10	-44.71	-238.82	52.81	-0.00	-0.00	-0.00	0.00	0.00
b011-1RMX	X3Y	15.35	-36.81	175.60	39.88	-0.00	-0.00	-0.00	0.00	0.00
b012-1RMN	X3S	-46.74	-42.89	302.95	63.44	-0.00	-0.00	-0.00	0.00	0.00
b012-1RMN	X3X	16.69	-17.62	-109.50	24.27	-0.00	-0.00	-0.00	0.00	0.00
b012-1RMN	X3XY	-29.93	-46.47	-252.96	55.28	-0.00	-0.00	-0.00	0.00	0.00
b012-1RMN	X3Y	13.65	-35.04	162.45	37.61	-0.00	-0.00	-0.00	0.00	0.00
b013-2RMX	X3S	-47.97	-46.37	326.09	66.72	-0.00	-0.00	-0.00	0.00	0.00
b013-2RMX	X3X	14.39	-14.83	-84.12	20.66	-0.00	-0.00	-0.00	0.00	0.00
b013-2RMX	X3XY	-28.40	-45.74	-248.74	53.84	-0.00	-0.00	-0.00	0.00	0.00
b013-2RMX	X3Y	15.65	-35.09	164.27	38.42	-0.00	-0.00	-0.00	0.00	0.00
b014-2R MN	X3S	-46.27	-44.61	312.91	64.27	-0.00	-0.00	-0.00	0.00	0.00
b014-2R MN	X3X	16.21	-16.59	-98.22	23.20	-0.00	-0.00	-0.00	0.00	0.00
b014-2R MN	X3XY	-30.22	-47.50	-262.84	56.30	-0.00	-0.00	-0.00	0.00	0.00
b014-2R MN	X3Y	13.95	-33.33	151.09	36.13	-0.00	-0.00	-0.00	0.00	0.00
b015-3RMX	X3S	-33.29	-41.42	253.43	53.14	-0.00	-0.00	-0.00	0.00	0.00
b015-3RMX	X3X	20.60	-28.64	-156.60	35.28	-0.00	-0.00	-0.00	0.00	0.00
b015-3RMX	X3XY	-22.01	-31.93	-174.86	38.78	-0.00	-0.00	-0.00	0.00	0.00
b015-3RMX	X3Y	30.15	-40.04	235.54	50.12	-0.00	-0.00	-0.00	0.00	0.00
b016-3RMN	X3S	-31.59	-39.66	240.24	50.70	-0.00	-0.00	-0.00	0.00	0.00
b016-3RMN	X3X	22.43	-30.40	-170.69	37.78	-0.00	-0.00	-0.00	0.00	0.00
b016-3RMN	X3XY	-23.83	-33.69	-188.95	41.27	-0.00	-0.00	-0.00	0.00	0.00
b016-3RMN	X3Y	28.45	-38.28	222.35	47.69	-0.00	-0.00	-0.00	0.00	0.00
b017-NCLSMX	X3S	-34.04	-48.83	261.90	59.52	-0.00	-0.00	-0.00	0.00	0.00
b017-NCLSMX	X3X	21.66	-36.39	-169.00	42.35	-0.00	-0.00	-0.00	0.00	0.00
b017-NCLSMX	X3XY	-21.66	-36.39	-169.00	42.35	-0.00	-0.00	-0.00	0.00	0.00
b017-NCLSMX	X3Y	34.04	-48.83	261.90	59.52	-0.00	-0.00	-0.00	0.00	0.00
b018-NCLSMN	X3S	-33.66	-47.29	258.98	58.04	-0.00	-0.00	-0.00	0.00	0.00
b018-NCLSMN	X3X	24.36	-37.93	-189.93	45.08	-0.00	-0.00	-0.00	0.00	0.00
b018-NCLSMN	X3XY	-24.36	-37.93	-189.93	45.08	-0.00	-0.00	-0.00	0.00	0.00
b018-NCLSMN	X3Y	33.66	-47.29	258.98	58.04	-0.00	-0.00	-0.00	0.00	0.00
b019-PKLSMX	X3S	-27.14	-37.32	215.94	46.14	-0.00	-0.00	-0.00	0.00	0.00
b019-PKLSMX	X3X	6.89	-15.26	-47.35	16.74	-0.00	-0.00	-0.00	0.00	0.00
b019-PKLSMX	X3XY	-19.46	-29.61	-158.34	35.43	-0.00	-0.00	-0.00	0.00	0.00
b019-PKLSMX	X3Y	14.57	-22.97	104.95	27.21	-0.00	-0.00	-0.00	0.00	0.00
b020-PKLSMN	X3S	-27.36	-36.87	218.10	45.91	-0.00	-0.00	-0.00	0.00	0.00
b020-PKLSMN	X3X	8.13	-15.71	-56.45	17.69	-0.00	-0.00	-0.00	0.00	0.00
b020-PKLSMN	X3XY	-21.56	-31.04	-175.06	37.79	-0.00	-0.00	-0.00	0.00	0.00
b020-PKLSMN	X3Y	13.93	-21.54	99.49	25.65	-0.00	-0.00	-0.00	0.00	0.00
b021-1LLSMX	X3S	-21.30	-31.06	165.85	37.66	-0.00	-0.00	-0.00	0.00	0.00
b021-1LLSMX	X3X	11.48	-21.68	-95.36	24.53	-0.00	-0.00	-0.00	0.00	0.00
b021-1LLSMX	X3XY	-14.72	-22.45	-109.15	26.84	-0.00	-0.00	-0.00	0.00	0.00
b021-1LLSMX	X3Y	20.00	-28.22	151.78	34.59	-0.00	-0.00	-0.00	0.00	0.00
b022-1LLSMN	X3S	-21.07	-30.16	164.09	36.79	-0.00	-0.00	-0.00	0.00	0.00
b022-1LLSMN	X3X	13.03	-22.57	-107.38	26.06	-0.00	-0.00	-0.00	0.00	0.00
b022-1LLSMN	X3XY	-16.28	-23.34	-121.17	28.45	-0.00	-0.00	-0.00	0.00	0.00
b022-1LLSMN	X3Y	19.77	-27.33	150.02	33.73	-0.00	-0.00	-0.00	0.00	0.00
b023-2LLSMX	X3S	-26.93	-43.72	233.01	51.34	-0.00	-0.00	-0.00	0.00	0.00
b023-2LLSMX	X3X	-1.71	-16.92	-27.81	17.01	-0.00	-0.00	-0.00	0.00	0.00
b023-2LLSMX	X3XY	-27.72	-27.20	-175.17	38.83	-0.00	-0.00	-0.00	0.00	0.00
b023-2LLSMX	X3Y	14.17	-15.56	83.10	21.05	-0.00	-0.00	-0.00	0.00	0.00
b024-2LLSMN	X3S	-26.70	-42.82	231.28	50.47	-0.00	-0.00	-0.00	0.00	0.00
b024-2LLSMN	X3X	-0.16	-17.81	-39.86	17.81	-0.00	-0.00	-0.00	0.00	0.00
b024-2LLSMN	X3XY	-29.28	-28.09	-187.23	40.57	-0.00	-0.00	-0.00	0.00	0.00
b024-2LLSMN	X3Y	13.95	-14.67	81.37	20.24	-0.00	-0.00	-0.00	0.00	0.00
b025-3LLSMX	X3S	-26.97	-44.90	242.05	52.38	-0.00	-0.00	-0.00	0.00	0.00
b025-3LLSMX	X3X	-1.67	-15.63	-17.72	15.72	-0.00	-0.00	-0.00	0.00	0.00
b025-3LLSMX	X3XY	-27.49	-28.49	-183.81	39.59	-0.00	-0.00	-0.00	0.00	0.00
b025-3LLSMX	X3Y	13.94	-14.38	72.61	20.03	-0.00	-0.00	-0.00	0.00	0.00
b026-3LLSMN	X3S	-26.75	-44.01	240.34	51.50	-0.00	-0.00	-0.00	0.00	0.00
b026-3LLSMN	X3X	-0.11	-16.52	-29.79	16.52	-0.00	-0.00	-0.00	0.00	0.00
b026-3LLSMN	X3XY	-29.05	-29.38	-195.88	41.31	-0.00	-0.00	-0.00	0.00	0.00

b026-3LLSMN	X3Y	13.72	-13.49	70.89	19.24	-0.00	-0.00	-0.00	0.00	0.00
b027-NCRSMX	X3S	-37.87	-48.83	291.49	61.79	-0.00	-0.00	-0.00	0.00	0.00
b027-NCRSMX	X3X	25.48	-36.39	-198.60	44.42	-0.00	-0.00	-0.00	0.00	0.00
b027-NCRSMX	X3XY	-25.48	-36.39	-198.60	44.42	-0.00	-0.00	-0.00	0.00	0.00
b027-NCRSMX	X3Y	37.87	-48.83	291.49	61.79	-0.00	-0.00	-0.00	0.00	0.00
b028-NCRSMN	X3S	-35.16	-47.28	270.57	58.93	-0.00	-0.00	-0.00	0.00	0.00
b028-NCRSMN	X3X	25.86	-37.93	-201.52	45.91	-0.00	-0.00	-0.00	0.00	0.00
b028-NCRSMN	X3XY	-25.86	-37.93	-201.52	45.91	-0.00	-0.00	-0.00	0.00	0.00
b028-NCRSMN	X3Y	35.16	-47.28	270.57	58.93	-0.00	-0.00	-0.00	0.00	0.00
b029-PKRSMX	X3S	-29.53	-37.32	234.43	47.59	-0.00	-0.00	-0.00	0.00	0.00
b029-PKRSMX	X3X	9.29	-15.26	-65.85	17.86	-0.00	-0.00	-0.00	0.00	0.00
b029-PKRSMX	X3XY	-21.85	-29.61	-176.84	36.80	-0.00	-0.00	-0.00	0.00	0.00
b029-PKRSMX	X3Y	16.97	-22.97	123.44	28.56	-0.00	-0.00	-0.00	0.00	0.00
b030-PKRSMN	X3S	-27.86	-36.38	221.53	45.82	-0.00	-0.00	-0.00	0.00	0.00
b030-PKRSMN	X3X	9.50	-16.20	-67.50	18.78	-0.00	-0.00	-0.00	0.00	0.00
b030-PKRSMN	X3XY	-22.06	-30.55	-178.49	37.68	-0.00	-0.00	-0.00	0.00	0.00
b030-PKRSMN	X3Y	15.30	-22.03	110.54	26.82	-0.00	-0.00	-0.00	0.00	0.00
b031-1RRSMX	X3S	-24.49	-30.02	182.88	38.75	-0.00	-0.00	-0.00	0.00	0.00
b031-1RRSMX	X3X	14.67	-20.64	-112.39	25.33	-0.00	-0.00	-0.00	0.00	0.00
b031-1RRSMX	X3XY	-15.97	-23.48	-126.47	28.39	-0.00	-0.00	-0.00	0.00	0.00
b031-1RRSMX	X3Y	21.24	-29.25	169.10	36.15	-0.00	-0.00	-0.00	0.00	0.00
b032-1RRSMN	X3S	-22.94	-29.13	170.86	37.08	-0.00	-0.00	-0.00	0.00	0.00
b032-1RRSMN	X3X	14.90	-21.54	-114.15	26.19	-0.00	-0.00	-0.00	0.00	0.00
b032-1RRSMN	X3XY	-16.20	-24.37	-128.23	29.26	-0.00	-0.00	-0.00	0.00	0.00
b032-1RRSMN	X3Y	19.69	-28.36	157.08	34.53	-0.00	-0.00	-0.00	0.00	0.00
b033-2RRSMX	X3S	-37.50	-34.78	249.01	51.14	-0.00	-0.00	-0.00	0.00	0.00
b033-2RRSMX	X3X	8.85	-7.98	-43.80	11.92	-0.00	-0.00	-0.00	0.00	0.00
b033-2RRSMX	X3XY	-21.61	-36.14	-193.72	42.11	-0.00	-0.00	-0.00	0.00	0.00
b033-2RRSMX	X3Y	8.06	-24.50	101.64	25.79	-0.00	-0.00	-0.00	0.00	0.00
b034-2RRSMN	X3S	-35.94	-33.89	236.95	49.40	-0.00	-0.00	-0.00	0.00	0.00
b034-2RRSMN	X3X	9.08	-8.88	-45.53	12.70	-0.00	-0.00	-0.00	0.00	0.00
b034-2RRSMN	X3XY	-21.84	-37.03	-195.44	42.99	-0.00	-0.00	-0.00	0.00	0.00
b034-2RRSMN	X3Y	6.51	-23.61	89.58	24.49	-0.00	-0.00	-0.00	0.00	0.00
b035-3RRSMX	X3S	-37.27	-36.07	257.67	51.86	-0.00	-0.00	-0.00	0.00	0.00
b035-3RRSMX	X3X	8.68	-6.80	-33.34	11.99	-0.00	-0.00	-0.00	0.00	0.00
b035-3RRSMX	X3XY	-21.66	-37.32	-202.78	43.15	-0.00	-0.00	-0.00	0.00	0.00
b035-3RRSMX	X3Y	8.11	-23.21	94.38	24.00	-0.00	-0.00	-0.00	0.00	0.00
b036-3RRSMN	X3S	-35.71	-35.18	245.61	50.13	-0.00	-0.00	-0.00	0.00	0.00
b036-3RRSMN	X3X	8.85	-7.69	-35.06	11.73	-0.00	-0.00	-0.00	0.00	0.00
b036-3RRSMN	X3XY	-21.88	-38.21	-204.50	44.03	-0.00	-0.00	-0.00	0.00	0.00
b036-3RRSMN	X3Y	6.55	-22.32	79.51	23.26	-0.00	-0.00	-0.00	0.00	0.00

Summary of Joint Support Reactions For All Load Cases in Direction of Leg:

Load Case	Support Origin	Leg	Force In	Residual	Shear	Residual	Shear	Total	Total
Vert.									
Force					To Leg	To Leg	Force	Force	
(kN)			(kN)	(kN)	(kN)	(kN)	(kN)	(kN)	(kN)

b001-NCMX	X3S	X2S	M12P	394.443	12.617	12.725	-50.20	-62.66	
386.39									
b001-NCMX	X3X	X2X	M12X	-283.973	12.350	12.451	35.93	-48.35	
-277.79									
b001-NCMX	X3XY	X2XY	M12XY	-288.803	13.862	13.972	-36.25	-50.46	
-282.38									
b001-NCMX	X3Y	X2Y	M12Y	399.273	14.125	14.241	50.52	-64.77	
390.99									
b002-NCMN	X3S	X2S	M12P	388.709	14.338	14.458	-49.38	-63.64	
380.54									
b002-NCMN	X3X	X2X	M12X	-304.278	13.916	14.027	38.28	-52.48	
-297.59									
b002-NCMN	X3XY	X2XY	M12XY	-304.278	13.916	14.027	-38.28	-52.48	
-297.59									
b002-NCMN	X3Y	X2Y	M12Y	388.709	14.338	14.458	49.38	-63.64	
380.54									

b003-PKMX 308.10	X3S	X2S	M12P	314.256	9.063	9.124	-38.99	-48.90
b003-PKMX -109.71	X3X	X2X	M12X	-112.751	8.767	8.852	15.02	-22.99
b003-PKMX -228.32	X3XY	X2XY	M12XY	-233.086	8.825	8.880	-28.44	-38.32
b003-PKMX 189.49	X3Y	X2Y	M12Y	193.921	9.054	9.146	25.56	-33.57
b004PKMN 290.26	X3S	X2S	M12P	296.131	9.057	9.118	-36.75	-46.60
b004PKMN -127.54	X3X	X2X	M12X	-130.877	8.762	8.847	17.26	-25.30
b004PKMN -238.53	X3XY	X2XY	M12XY	-243.479	8.817	8.873	-29.83	-39.64
b004PKMN 179.27	X3Y	X2Y	M12Y	183.528	9.048	9.139	24.18	-32.25
b005-1LMX 318.90	X3S	X2S	M12P	325.632	14.099	14.173	-38.69	-55.16
b005-1LMX -98.17	X3X	X2X	M12X	-100.569	15.613	15.632	5.11	-26.36
b005-1LMX -238.67	X3XY	X2XY	M12XY	-243.984	7.973	8.089	-38.20	-34.21
b005-1LMX 175.44	X3Y	X2Y	M12Y	179.164	4.496	4.569	25.45	-26.30
b006-1LMN 304.76	X3S	X2S	M12P	311.270	14.161	14.236	-36.86	-53.40
b006-1LMN -111.31	X3X	X2X	M12X	-113.939	15.669	15.688	6.81	-28.12
b006-1LMN -251.81	X3XY	X2XY	M12XY	-257.354	7.999	8.116	-39.90	-35.97
b006-1LMN 161.31	X3Y	X2Y	M12Y	164.801	4.546	4.620	23.62	-24.54
b007-2LMX 328.72	X3S	X2S	M12P	335.458	14.088	14.148	-38.98	-56.19
b007-2LMX -86.74	X3X	X2X	M12X	-89.148	14.604	14.636	5.39	-24.64
b007-2LMX -248.57	X3XY	X2XY	M12XY	-251.878	6.762	6.762	-37.71	-35.93
b007-2LMX 164.10	X3Y	X2Y	M12Y	167.812	5.447	5.537	24.96	-25.27
b008-2LMN 314.62	X3S	X2S	M12P	321.131	14.145	14.205	-37.15	-54.42
b008-2LMN -99.92	X3X	X2X	M12X	-102.554	14.658	14.690	7.10	-26.40
b008-2LMN -261.75	X3XY	X2XY	M12XY	-267.285	6.689	6.797	-39.42	-37.69
b008-2LMN 150.00	X3Y	X2Y	M12Y	153.485	5.490	5.581	23.14	-23.51
b009-3LMX 338.72	X3S	X2S	M12P	345.467	14.464	14.509	-39.03	-57.49
b009-3LMX -75.74	X3X	X2X	M12X	-78.151	14.071	14.118	5.45	-23.22
b009-3LMX -258.12	X3XY	X2XY	M12XY	-263.428	5.633	5.726	-37.47	-37.34
b009-3LMX 152.65	X3Y	X2Y	M12Y	156.357	6.449	6.555	24.72	-23.98
b010-3LMN 324.62	X3S	X2S	M12P	331.150	14.519	14.564	-37.21	-55.72
b010-3LMN -88.93	X3X	X2X	M12X	-91.568	14.126	14.174	7.16	-24.99
b010-3LMN -271.31	X3XY	X2XY	M12XY	-276.845	5.673	5.767	-39.18	-39.11
b010-3LMN 138.56	X3Y	X2Y	M12Y	142.040	6.486	6.592	22.90	-22.21
b011-1RMX 316.10	X3S	X2S	M12P	322.783	8.369	8.493	-48.44	-44.66
b011-1RMX -95.37	X3X	X2X	M12X	-97.719	4.279	4.348	14.86	-15.86
b011-1RMX -238.82	X3XY	X2XY	M12XY	-244.188	14.050	14.120	-28.10	-44.71
b011-1RMX	X3Y	X2Y	M12Y	179.368	15.885	15.908	15.35	-36.81



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175.60										
b012-1RMN	X3S	X2S	M12P	309.412	8.341	8.464	-46.74	-42.89		
302.95										
b012-1RMN	X3X	X2X	M12X	-112.082	4.229	4.297	16.69	-17.62		
-109.50										
b012-1RMN	X3XY	X2XY	M12XY	-258.550	13.987	14.057	-29.93	-46.47		
-252.96										
b012-1RMN	X3Y	X2Y	M12Y	165.997	15.828	15.851	13.65	-35.04		
162.45										
b013-2RMX	X3S	X2S	M12P	332.772	7.089	7.203	-47.97	-46.37		
326.09										
b013-2RMX	X3X	X2X	M12X	-86.462	5.209	5.295	14.39	-14.83		
-84.12										
b013-2RMX	X3XY	X2XY	M12XY	-254.108	14.045	14.101	-28.40	-45.74		
-248.74										
b013-2RMX	X3Y	X2Y	M12Y	168.042	14.903	14.940	15.65	-35.09		
164.27										
b014-2R MN	X3S	X2S	M12P	319.366	7.054	7.168	-46.27	-44.61		
312.91										
b014-2R MN	X3X	X2X	M12X	-100.789	5.166	5.251	16.21	-16.59		
-98.22										
b014-2R MN	X3XY	X2XY	M12XY	-268.435	13.989	14.044	-30.22	-47.50		
-262.84										
b014-2R MN	X3Y	X2Y	M12Y	154.635	14.848	14.885	13.95	-33.33		
151.09										
b015-3RMX	X3S	X2S	M12P	258.800	8.609	8.689	-33.29	-41.42		
253.43										
b015-3RMX	X3X	X2X	M12X	-160.312	8.335	8.409	20.60	-28.64		
-156.60										
b015-3RMX	X3XY	X2XY	M12XY	-178.866	9.282	9.348	-22.01	-31.93		
-174.86										
b015-3RMX	X3Y	X2Y	M12Y	240.622	9.530	9.604	30.15	-40.04		
235.54										
b016-3RMN	X3S	X2S	M12P	245.384	8.552	8.630	-31.59	-39.66		
240.24										
b016-3RMN	X3X	X2X	M12X	-174.629	8.278	8.351	22.43	-30.40		
-170.69										
b016-3RMN	X3XY	X2XY	M12XY	-193.183	9.225	9.291	-23.83	-33.69		
-188.95										
b016-3RMN	X3Y	X2Y	M12Y	227.205	9.472	9.545	28.45	-38.28		
222.35										
b017-NCLSMX	X3S	X2S	M12P	268.165	14.857	14.982	-34.04	-48.83		
261.90										
b017-NCLSMX	X3X	X2X	M12X	-173.625	14.435	14.550	21.66	-36.39		
-169.00										
b017-NCLSMX	X3XY	X2XY	M12XY	-173.625	14.435	14.550	-21.66	-36.39		
-169.00										
b017-NCLSMX	X3Y	X2Y	M12Y	268.165	14.857	14.982	34.04	-48.83		
261.90										
b018-NCLSMN	X3S	X2S	M12P	265.047	13.703	13.818	-33.66	-47.29		
258.98										
b018-NCLSMN	X3X	X2X	M12X	-194.751	13.281	13.387	24.36	-37.93		
-189.93										
b018-NCLSMN	X3XY	X2XY	M12XY	-194.751	13.281	13.387	-24.36	-37.93		
-189.93										
b018-NCLSMN	X3Y	X2Y	M12Y	265.047	13.703	13.818	33.66	-47.29		
258.98										
b019-PKLSMX	X3S	X2S	M12P	220.612	9.381	9.445	-27.14	-37.32		
215.94										
b019-PKLSMX	X3X	X2X	M12X	-49.398	9.086	9.173	6.89	-15.26		
-47.35										
b019-PKLSMX	X3XY	X2XY	M12XY	-162.001	9.141	9.199	-19.46	-29.61		
-158.34										
b019-PKLSMX	X3Y	X2Y	M12Y	108.009	9.371	9.464	14.57	-22.97		
104.95										
b020-PKLSMN	X3S	X2S	M12P	222.708	8.668	8.726	-27.36	-36.87		
218.10										
b020-PKLSMN	X3X	X2X	M12X	-58.557	8.372	8.454	8.13	-15.71		
-56.45										
b020-PKLSMN	X3XY	X2XY	M12XY	-178.892	8.432	8.484	-21.56	-31.04		
-175.06										



b020-PKLSMN 99.49	X3Y	X2Y	M12Y	102.373	8.660	8.748	13.93	-21.54
b021-1LLSMX 165.85	X3S	X2S	M12P	169.805	9.547	9.623	-21.30	-31.06
b021-1LLSMX -95.36	X3X	X2X	M12X	-98.021	9.328	9.390	11.48	-21.68
b021-1LLSMX -109.15	X3XY	X2XY	M12XY	-112.092	8.285	8.363	-14.72	-22.45
b021-1LLSMX 151.78	X3Y	X2Y	M12Y	155.435	8.542	8.618	20.00	-28.22
b022-1LLSMN 164.09	X3S	X2S	M12P	167.932	8.889	8.960	-21.07	-30.16
b022-1LLSMN -107.38	X3X	X2X	M12X	-110.158	8.673	8.730	13.03	-22.57
b022-1LLSMN -121.17	X3XY	X2XY	M12XY	-124.229	7.630	7.702	-16.28	-23.34
b022-1LLSMN 150.02	X3Y	X2Y	M12Y	153.562	7.885	7.956	19.77	-27.33
b023-2LLSMX 233.01	X3S	X2S	M12P	238.192	13.908	13.971	-26.93	-43.72
b023-2LLSMX -27.81	X3X	X2X	M12X	-29.286	14.310	14.347	-1.71	-16.92
b023-2LLSMX -175.17	X3XY	X2XY	M12XY	-179.301	6.716	6.827	-27.72	-27.20
b023-2LLSMX 83.10	X3Y	X2Y	M12Y	85.522	5.826	5.920	14.17	-15.56
b024-2LLSMN 231.28	X3S	X2S	M12P	236.354	13.264	13.322	-26.70	-42.82
b024-2LLSMN -39.86	X3X	X2X	M12X	-41.458	13.697	13.728	-0.16	-17.81
b024-2LLSMN -187.23	X3XY	X2XY	M12XY	-191.473	6.298	6.400	-29.28	-28.09
b024-2LLSMN 81.37	X3Y	X2Y	M12Y	83.684	5.302	5.389	13.95	-14.67
b025-3LLSMX 242.05	X3S	X2S	M12P	247.242	14.334	14.283	-26.97	-44.90
b025-3LLSMX -17.72	X3X	X2X	M12X	-20.200	13.917	13.917	-1.67	-15.63
b025-3LLSMX -183.81	X3XY	X2XY	M12XY	-187.934	5.932	6.029	-27.49	-28.49
b025-3LLSMX 72.61	X3Y	X2Y	M12Y	75.026	6.652	6.762	13.94	-14.38
b026-3LLSMN 240.34	X3S	X2S	M12P	245.414	13.602	13.646	-26.75	-44.01
b026-3LLSMN -29.79	X3X	X2X	M12X	-31.389	13.231	13.277	-0.11	-16.52
b026-3LLSMN -195.88	X3XY	X2XY	M12XY	-200.116	5.429	5.519	-29.05	-29.38
b026-3LLSMN 70.89	X3Y	X2Y	M12Y	73.198	6.181	6.283	13.72	-13.49
b027-NCRSMX 291.49	X3S	X2S	M12P	297.766	11.063	11.157	-37.87	-48.83
b027-NCRSMX -198.60	X3X	X2X	M12X	-203.225	10.641	10.725	25.48	-36.39
b027-NCRSMX -198.60	X3XY	X2XY	M12XY	-203.225	10.641	10.725	-25.48	-36.39
b027-NCRSMX 291.49	X3Y	X2Y	M12Y	297.766	11.063	11.157	37.87	-48.83
b028-NCRSMN 270.57	X3S	X2S	M12P	276.639	12.217	12.320	-35.16	-47.28
b028-NCRSMN -201.52	X3X	X2X	M12X	-206.344	11.796	11.889	25.86	-37.93
b028-NCRSMN -201.52	X3XY	X2XY	M12XY	-206.344	11.796	11.889	-25.86	-37.93
b028-NCRSMN 270.57	X3Y	X2Y	M12Y	276.639	12.217	12.320	35.16	-47.28
b029-PKRSMX 234.43	X3S	X2S	M12P	239.113	7.019	7.064	-29.53	-37.32
b029-PKRSMX -65.85	X3X	X2X	M12X	-67.899	6.726	6.793	9.29	-15.26
b029-PKRSMX	X3XY	X2XY	M12XY	-180.501	6.788	6.827	-21.85	-29.61



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-176.84									
b029-PKRSMX	X3Y	X2Y	M12Y	126.510	7.017	7.091	16.97	-22.97	
123.44									
b030-PKRSMN	X3S	X2S	M12P	226.088	7.737	7.788	-27.86	-36.38	
221.53									
b030-PKRSMN	X3X	X2X	M12X	-69.669	7.443	7.517	9.50	-16.20	
-67.50									
b030-PKRSMN	X3XY	X2XY	M12XY	-182.271	7.502	7.547	-22.06	-30.55	
-178.49									
b030-PKRSMN	X3Y	X2Y	M12Y	113.485	7.732	7.812	15.30	-22.03	
110.54									
b031-1RRSMX	X3S	X2S	M12P	186.834	6.381	6.447	-24.49	-30.02	
182.88									
b031-1RRSMX	X3X	X2X	M12X	-115.050	6.070	6.122	14.67	-20.64	
-112.39									
b031-1RRSMX	X3XY	X2XY	M12XY	-129.420	7.090	7.142	-15.97	-23.48	
-126.47									
b031-1RRSMX	X3Y	X2Y	M12Y	172.763	7.376	7.426	21.24	-29.25	
169.10									
b032-1RRSMN	X3S	X2S	M12P	174.697	7.033	7.105	-22.94	-29.13	
170.86									
b032-1RRSMN	X3X	X2X	M12X	-116.923	6.727	6.785	14.90	-21.54	
-114.15									
b032-1RRSMN	X3XY	X2XY	M12XY	-131.294	7.747	7.804	-16.20	-24.37	
-128.23									
b032-1RRSMN	X3Y	X2Y	M12Y	160.626	8.032	8.087	19.69	-28.36	
157.08									
b033-2RRSMX	X3S	X2S	M12P	254.138	5.832	5.918	-37.50	-34.78	
249.01									
b033-2RRSMX	X3X	X2X	M12X	-45.231	3.886	3.949	8.85	-7.98	
-43.80									
b033-2RRSMX	X3XY	X2XY	M12XY	-197.901	11.575	11.616	-21.61	-36.14	
-193.72									
b033-2RRSMX	X3Y	X2Y	M12Y	104.122	12.420	12.446	8.06	-24.50	
101.64									
b034-2RRSMN	X3S	X2S	M12P	241.966	6.144	6.240	-35.94	-33.89	
236.95									
b034-2RRSMN	X3X	X2X	M12X	-747.069	4.304	4.376	9.08	-8.88	
-45.53									
b034-2RRSMN	X3XY	X2XY	M12XY	-199.739	12.210	12.256	-21.84	-37.03	
-195.44									
b034-2RRSMN	X3Y	X2Y	M12Y	91.950	13.028	13.058	6.51	-23.61	
89.58									
b035-3RRSMX	X3S	X2S	M12P	262.797	4.763	4.840	-37.27	-36.07	
257.67									
b035-3RRSMX	X3X	X2X	M12X	-34.762	4.910	4.986	8.63	-6.80	
-33.34									
b035-3RRSMX	X3XY	X2XY	M12XY	-206.979	11.977	12.006	-21.66	-37.32	
-202.78									
b035-3RRSMX	X3Y	X2Y	M12Y	94.070	11.930	11.969	8.11	-23.21	
91.58									
b036-3RRSMN	X3S	X2S	M12P	250.615	5.166	5.251	-35.71	-35.18	
245.61									
b036-3RRSMN	X3X	X2X	M12X	-36.590	5.267	5.352	8.85	-7.69	
-35.06									
b036-3RRSMN	X3XY	X2XY	M12XY	-208.806	12.594	12.628	-21.88	-38.21	
-204.50									
b036-3RRSMN	X3Y	X2Y	M12Y	81.888	12.562	12.607	6.55	-22.32	
79.51									



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Overturning Moment Summary For All Load Cases:

Load Case	Transverse Moment (kN-m)	Longitudinal Moment (kN-m)	Resultant Moment (kN-m)
b001-NCMX	6431.576	-0.000	6431.576
b002-NCMN	6521.575	-0.000	6521.575
b003-PKMX	4018.067	1140.682	4176.843
b004PKMN	4018.067	1067.386	4157.424

b005-1LMX	3996.709	1365.390	4223.502
b006-1LMN	3987.170	1365.390	4214.477
b007-2LMX	3982.034	1569.690	4280.247
b008-2LMN	3973.177	1569.690	4272.009
b009-3LMX	3968.125	1771.669	4345.667
b010-3LMN	3959.464	1771.669	4337.760
b011-1RMX	3971.272	1365.390	4199.440
b012-1RMN	3980.811	1365.390	4208.461
b013-2RMX	3958.416	1569.690	4258.284
b014-2R MN	3967.273	1569.690	4266.518
b015-3RMX	3945.029	173.825	3948.857
b016-3RMN	3953.690	173.825	3957.509
b017-NCLSMX	4143.928	-0.000	4143.928
b018-NCLSMN	4317.087	-0.000	4317.087
b019-PKLSMX	2532.047	1067.386	2747.831
b020-PKLSMN	2640.272	1140.683	2876.142
b021-1LLSMX	2510.689	133.963	2514.260
b022-1LLSMN	2609.375	133.963	2612.811
b023-2LLSMX	2496.014	1429.470	2876.364
b024-2LLSMN	2595.382	1429.470	2963.003
b025-3LLSMX	2482.105	1613.406	2960.393
b026-3LLSMN	2581.669	1613.406	3044.354
b027-NCRSMX	4713.189	-0.000	4713.189
b028-NCRSMN	4540.030	-0.000	4540.030
b029-PKRSMX	2887.842	1067.386	3078.789
b030-PKRSMN	2779.617	1067.386	2977.513
b031-1RRSMX	2841.047	133.963	2844.203
b032-1RRSMN	2742.361	133.963	2745.631
b033-2RRSMX	2828.190	1429.470	3168.918
b034-2RRSMN	2728.822	1429.470	3080.561
b035-3RRSMX	2814.804	1613.406	3244.410
b036-3RRSMN	2715.240	1613.406	3158.419

*** Overall summary for all load cases - Usage = Maximum Stress / Allowable Stress
Printed capacities do not include the strength factor entered for each loadcase.



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Group Summary (Compression Portion)

Group Comp.	Group Conn.	Group Angle	Angle	Steel	Max	Max	Comp.	Comp.	Comp.	L/R
Label	Desc.	Type	RLX	RLY	RLZ	L/R	Length	Curve	No. Of	
Shear	Bearing		Size	Strength	Usage	Use In	Control	Force	Control	Capacity
Capacity	Capacity			(MPa)	%	Member	Member	Comp.	Load Case	(kN)
(kN)	(kN)					(m)		(kN)		
M1	M1	SAE	100*100*7	355.0	83.12	83.12	M1P	-329.636	b001-NCMX	396.599
720.000	514.080	0.250	0.250	0.250	54.31	4.280	1	6		
M2	M2	SAE	90*90*7	355.0	89.45	89.45	M2P	-322.034	b001-NCMX	384.104
360.000	514.080	0.250	0.250	0.250	49.10	3.456	1	6		
M3	M3	SAE	90*90*7	355.0	78.84	78.84	M3P	-296.929	b001-NCMX	376.600
720.000	514.080	0.330	0.330	0.330	52.89	2.821	1	6		
M4	M4	SAE	90*90*7	355.0	81.95	81.95	M4Y	-286.610	b001-NCMX	349.724
720.000	514.080	0.500	0.500	0.500	64.69	2.277	1	6		
M5	M5	SAE	90*90*6	355.0	83.46	83.46	M5P	-250.469	b009-3LMX	300.091
720.000	440.640	0.500	0.500	0.500	52.98	1.876	1	6		
M6	M6	SAE	75*75*6	355.0	93.26	93.26	M6P	-223.827	b009-3LMX	289.275
240.000	293.760	0.500	0.500	0.500	36.18	1.064	1	4		
M7	M7	SAE	60*60*6	355.0	73.39	73.39	M7P	-118.000	b003-PKMX	160.780
240.000	293.760	1.000	1.000	1.000	86.72	1.015	1	4		
D1	D1	SAE	50*50*5	275.0	69.43	69.43	D1P	-20.258	b012-1RMN	29.179
120.000	98.400	0.450	0.450	0.276	198.64	6.710	5	2		
D2	D2	SAE	50*50*5	275.0	65.98	65.98	D2Y	-19.252	b009-3LMX	29.179
120.000	98.400	0.450	0.450	0.276	198.64	6.710	5	2		
D5	D5	SAE	45*45*5	275.0	80.47	80.47	D5X	-24.782	b005-1LMX	30.796
120.000	98.400	0.450	0.450	0.276	179.71	5.431	5	2		
D6	D6	SAE	45*45*5	275.0	71.68	71.68	D6P	-22.075	b012-1RMN	30.796

120.000		98.400	0.450	0.450	0.276	179.71	5.431	5	2			
D9	D9	SAE	50*50*5		275.0	73.54	73.54	D9P	-30.755	b012-1RMN	41.823	
120.000		98.400	0.550	0.550	0.220	159.73	4.414	5	2			
D10	D10	SAE	50*50*5		275.0	69.87	69.87	D10Y	-29.223	b009-3LMX	41.823	
120.000		98.400	0.550	0.550	0.220	159.73	4.414	5	2			
D11	D11	SAE	45*45*5		275.0	85.90	85.90	D11X	-37.706	b005-1LMX	43.896	
120.000		98.400	0.550	0.550	0.220	144.43	3.571	5	2			
D12	D12	SAE	45*45*5		275.0	76.50	76.50	D12P	-33.579	b012-1RMN	43.896	
120.000		98.400	0.550	0.550	0.220	144.43	3.571	5	2			
D13	D13	SAE	45*45*5		275.0	78.90	78.90	D13P	-47.121	b012-1RMN	59.725	
120.000		98.400	0.550	0.550	0.220	117.71	2.911	3	2			
D14	D14	SAE	45*45*5		275.0	74.96	74.96	D14Y	-44.770	b009-3LMX	59.725	
120.000		98.400	0.550	0.550	0.220	117.71	2.911	3	2			
D15	D15	SAE	45*45*5		275.0	60.21	60.21	D15X	-22.268	b011-1RMX	36.983	
120.000		98.400	0.500	0.500	0.500	160.71	2.828	5	2			
D16	D16	SAE	45*45*5		275.0	72.72	72.72	D162P	-48.911	b014-2R MN	67.264	
120.000		98.400	1.000	1.000	0.500	101.68	1.383	3	2			
D17	D17	SAE	45*45*5		275.0	82.75	82.75	D172Y	-55.661	b008-2LMN	67.264	
120.000		98.400	1.000	1.000	0.500	101.68	1.383	3	2			
D18	D18	SAE	50*50*5		275.0	75.13	75.13	D18X	-58.045	b007-2LMX	77.257	
120.000		98.400	0.500	0.500	0.250	97.85	2.975	3	2			
D19	D19	SAE	50*50*5		275.0	85.47	85.47	D19P	-66.034	b013-2RMX	77.257	
120.000		98.400	0.500	0.500	0.250	97.85	2.975	3	2			
D20	D20	SAE	45*45*5		275.0	47.18	47.18	D20P	-21.103	b013-2RMX	44.732	
120.000		98.400	0.500	0.500	0.500	142.72	2.512	5	2			
D21	D21	SAE	45*45*5		275.0	75.48	75.48	D212X	-53.168	b009-3LMX	70.436	
120.000		98.400	1.000	1.000	0.500	94.58	1.286	3	2			
D22	D22	SAE	45*45*5		275.0	75.69	75.69	D222Y	-53.312	b009-3LMX	70.436	
120.000		98.400	1.000	1.000	0.500	94.58	1.286	3	2			
D23	D23	SAE	50*50*5		275.0	86.43	86.43	D23X	-68.270	b010-3LMN	78.986	
120.000		98.400	0.500	0.500	0.250	94.36	2.869	3	2			
D24	D24	SAE	50*50*5		275.0	81.45	81.45	D24Y	-64.331	b010-3LMN	78.986	
120.000		98.400	0.500	0.500	0.250	94.36	2.869	3	2			
D25	D25	SAE	45*45*5		275.0	30.77	30.77	D25X	-16.940	b009-3LMX	55.061	
120.000		98.400	0.500	0.500	0.500	124.95	2.199	5	2			
D26	D26	SAE	45*45*5		275.0	36.26	36.26	D26P	-17.842	b035-3RRSM	65.146	
60.000	49.200	0.500	0.500	0.500	0.500	106.30	1.871	3	1			
D27	D27	SAE	45*45*5		275.0	50.19	47.52	D27Y	-23.380	b027-NCRSM	65.146	
60.000	49.200	0.500	0.500	0.500	0.500	106.30	1.871	3	1			
D28	D28	SAE	45*45*5		275.0	16.07	11.98	D28P	-6.970	b036-3RRSM	58.173	
120.000		98.400	0.500	0.500	0.500	120.53	2.121	5	2			
D30	D30	SAE	50*50*5		275.0	66.60	66.60	D30XY	-18.843	b012-1RMN	28.292	
120.000		98.400	0.450	0.450	0.280	202.31	6.834	5	2			
D31	D31	SAE	50*50*5		275.0	51.90	51.90	D31X	-14.684	b005-1LMX	28.292	
120.000		98.400	0.450	0.450	0.280	202.31	6.834	5	2			
D38	D38	SAE	50*50*5		275.0	64.02	64.02	D38XY	-28.678	b011-1RMX	44.797	
120.000		98.400	0.320	0.320	0.160	153.07	7.271	5	2			
D39	D39	SAE	45*45*5		275.0	60.85	60.85	D39P	-20.320	b011-1RMX	33.395	
120.000		98.400	0.320	0.320	0.160	171.08	7.271	5	2			
D42	D42	SAE	55*55*5		275.0	80.59	80.59	D42XY	-29.134	b017-NCLSM	36.149	
120.000		98.400	0.400	0.400	0.200	185.10	7.728	5	2			
D43	D43	SAE	50*50*5		275.0	52.83	52.83	D43P	-14.816	b011-1RMX	28.044	
120.000		98.400	0.400	0.400	0.200	203.37	7.728	5	2			
H1	H1	SAE	50*50*5		275.0	32.05	22.07	H1P	-12.559	b002-NCMN	56.908	
120.000		98.400	1.000	1.000	0.500	131.58	2.000	5	2			
H2	H2	SAE	50*50*5		275.0	74.90	74.90	H2Y	-42.625	b011-1RMX	56.908	
120.000		98.400	1.000	1.000	0.500	131.58	2.000	5	2			
H3	H3	SAE	45*45*5		275.0	18.61	18.61	FH327X	-11.751	b005-1LMX	63.147	
120.000		98.400	1.000	1.000	1.000	110.57	0.973	3	2			
H4	H4	SAE	45*45*5		275.0	45.10	16.70	H4Y	-10.544	b012-1RMN	63.147	
120.000		98.400	1.000	1.000	1.000	110.57	0.973	3	2			
H5	H5	SAE	50*50*5		275.0	20.01	0.00	H5X	0.000		67.347	
120.000		98.400	1.000	1.000	0.500	116.85	1.776	3	2			
H6	H6	SAE	50*50*5		275.0	67.01	67.01	H6Y	-45.132	b013-2RMX	67.347	
120.000		98.400	1.000	1.000	0.500	116.85	1.776	3	2			
H7	H7	SAE	45*45*5		275.0	16.17	16.17	FH741X	-11.147	b007-2LMX	68.926	
120.000		98.400	1.000	1.000	1.000	97.99	0.862	3	2			
H8	H8	SAE	45*45*5		275.0	45.30	16.43	H8Y	-11.326	b014-2R MN	68.926	
120.000		98.400	1.000	1.000	1.000	97.99	0.862	3	2			
H9	H9	SAE	50*50*5		275.0	18.29	0.00	H9X	0.000		75.014	
120.000		98.400	1.000	1.000	0.500	102.29	1.555	3	2			

H10	H10	SAE	50*50*5	275.0	93.48	93.48	H10Y	-39.528	b009-3LMX	42.284
120.000		98.400	1.000 1.000	1.000	158.66	1.555	5	2		
H11	H11	SAE	50*50*5	275.0	36.37	36.37	H11X	-16.295	b001-NCMX	44.803
120.000		98.400	1.000 1.000	1.000	153.06	1.500	5	2		
H12	H12	SAE	50*50*5	275.0	31.72	11.38	H12Y	-5.097	b036-3RRSM	44.803
120.000		98.400	1.000 1.000	1.000	153.06	1.500	5	2		
H13	H13	SAE	60*60*5	275.0	26.55	26.55	H13P	-16.616	b009-3LMX	62.595
120.000		98.400	0.500 0.500	0.500	139.22	3.258	5	2		
H14	H14	SAE	60*60*5	275.0	19.80	19.80	FH1473P	-12.392	b012-1RMN	62.595
120.000		98.400	0.500 0.500	0.500	139.22	3.258	5	2		
H17	H17	SAE	60*60*5	275.0	39.83	39.83	H17Y	-17.683	b017-NCLSM	44.390
120.000		98.400	0.500 0.500	0.500	172.35	4.033	5	2		
H18	H18	SAE	60*60*5	275.0	20.26	20.26	FH1875X	-8.994	b006-1LMN	44.390
120.000		98.400	0.500 0.500	0.500	172.35	4.033	5	2		
B1	B1	SAE	75*75*6	275.0	74.08	74.08	B1P	-87.468	b005-1LMX	125.520
120.000		118.080	0.500 0.500	0.500	115.33	3.391	2	2		
B2	B2	SAE	70*70*6	275.0	77.42	77.42	B2P	-88.978	b007-2LMX	114.925
120.000		118.080	0.500 0.500	0.500	116.75	3.176	2	2		
B3	B3	SAE	60*60*6	355.0	83.26	83.26	B3P	-90.828	b009-3LMX	109.089
120.000		146.880	0.600 0.600	0.400	108.36	3.169	2	2		
T1	T1	SAE	50*50*5	275.0	44.73	44.73	T1X	-11.628	b012-1RMN	25.993
120.000		98.400	1.000 1.000	0.500	234.91	3.571	6	2		
T2	T2	SAE	45*45*5	275.0	57.74	57.74	T2X	-12.465	b014-2R MN	21.589
120.000		98.400	1.000 1.000	0.500	246.36	3.350	6	2		
T3	T3	SAE	45*45*5	275.0	59.34	51.99	T3P	-22.280	b010-3LMN	42.852
120.000		98.400	0.600 0.600	0.400	153.06	3.367	6	2		
P1	P1	SAE	50*50*6	275.0	42.38	42.38	P1P	-36.705	b003-PKMX	86.600
120.000		118.080	0.500 0.500	0.330	113.08	3.324	1	2		
M8	M8	SAE	100*100*7	355.0	81.75	81.75	M8P	-347.057	b001-NCMX	424.527
720.000		514.080	0.250 0.250	0.250	38.70	3.050	1	6		
M10	M10	SAE	100*100*7	355.0	86.85	86.85	M10P	-352.709	b001-NCMX	406.134
720.000		514.080	0.160 0.160	0.160	49.54	6.099	1	6		
M12	M12	SAE	100*100*8	355.0	83.01	83.01	M12Y	-374.414	b001-NCMX	451.029
720.000		587.520	0.200 0.200	0.200	62.24	6.099	1	6		
DUMM	DUMM	SAE	DUMMY	275.0	0.000	0.000	DUMMXY	0.177	b001-NCMX	0.209
120.000		5.904	0.500 0.500	0.500	365.64	4.607	5	2		



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Group Summary (Tension Portion):

Group Tens. Label	Group Conn. Desc.	Group Angle Type	Angle Conn. Tens.	Steel Conn. Strength	Max Length	Max No. Of Bolts	Tension Of Use In Control	Tension Of Hole Diameter	Tension Control	Net Section
Capacity (kN)	Capacity (kN)	Capacity (kN)	Capacity (kN)	Member (MPa)	Tens. (m)	%	%	(cm)	(kN)	(kN)
M1	M1	SAE	100*100*7	355.0	83.12	64.05	M1X	252.073	b002-NCMN	393.528
720.000		514.080	0.000	4.280	6	2.000	1.75			
M2	M2	SAE	90*90*7	355.0	89.45	71.44	M2XY	245.629	b010-3LMN	343.828
360.000		514.080	0.000	3.456	6	2.000	1.75			
M3	M3	SAE	90*90*7	355.0	78.84	68.03	M3XY	233.902	b010-3LMN	343.828
720.000		514.080	0.000	2.821	6	2.000	1.75			
M4	M4	SAE	90*90*7	355.0	81.95	67.25	M4XY	231.211	b010-3LMN	343.828
720.000		514.080	0.000	2.277	6	2.000	1.75			
M5	M5	SAE	90*90*6	355.0	83.46	71.42	M5XY	212.203	b010-3LMN	297.135
720.000		440.640	0.000	1.876	6	2.000	1.75			
M6	M6	SAE	75*75*6	355.0	93.26	76.65	M61XY	178.464	b010-3LMN	232.820
240.000		293.760	0.000	1.008	4	2.000	1.75			
M7	M7	SAE	60*60*6	355.0	73.39	55.89	M71XY	94.123	b029-PKRSM	168.405
240.000		293.760	0.000	0.977	4	2.000	1.75			
D1	D1	SAE	50*50*5	275.0	69.43	20.57	D1XY	19.923	b005-1LMX	96.864
120.000		98.400	0.000	6.710	2	1.000	1.75			
D2	D2	SAE	50*50*5	275.0	65.98	18.30	D2X	17.725	b012-1RMN	96.864
120.000		98.400	0.000	6.710	2	1.000	1.75			
D5	D5	SAE	45*45*5	275.0	80.47	29.34	D5Y	24.699	b012-1RMN	84.182
120.000		98.400	0.000	5.431	2	1.000	1.75			

120.000	D6	D6	SAE	45*45*5	275.0	71.68	27.87	D6XY	23.460	b009-3LMX	84.182
					0.000	5.431	2	1.000	1.75		
120.000	D9	D9	SAE	50*50*5	275.0	73.54	31.45	D9XY	30.468	b005-1LMX	96.864
					0.000	4.414	2	1.000	1.75		
120.000	D10	D10	SAE	50*50*5	275.0	69.87	28.00	D10X	27.119	b012-1RMN	96.864
					0.000	4.414	2	1.000	1.75		
120.000	D11	D11	SAE	45*45*5	275.0	85.90	44.83	D11Y	37.743	b012-1RMN	84.182
					0.000	3.571	2	1.000	1.75		
120.000	D12	D12	SAE	45*45*5	275.0	76.50	42.59	D12XY	35.854	b009-3LMX	84.182
					0.000	3.571	2	1.000	1.75		
120.000	D13	D13	SAE	45*45*5	275.0	78.90	55.63	D13XY	46.831	b005-1LMX	84.182
					0.000	2.911	2	1.000	1.75		
120.000	D14	D14	SAE	45*45*5	275.0	74.96	49.53	D14X	41.692	b012-1RMN	84.182
					0.000	2.911	2	1.000	1.75		
120.000	D15	D15	SAE	45*45*5	275.0	60.21	17.57	D15X	14.793	b006-1LMN	84.182
					0.000	2.828	2	1.000	1.75		
120.000	D16	D16	SAE	45*45*5	275.0	72.72	58.49	D162XY	49.242	b007-2LMX	84.182
					0.000	1.383	2	1.000	1.75		
120.000	D17	D17	SAE	45*45*5	275.0	82.75	66.55	D172X	56.022	b013-2RMX	84.182
					0.000	1.383	2	1.000	1.75		
120.000	D18	D18	SAE	50*50*5	275.0	75.13	59.48	D18Y	57.618	b014-2R MN	96.864
					0.000	2.975	2	1.000	1.75		
120.000	D19	D19	SAE	50*50*5	275.0	85.47	67.69	D19XY	65.572	b008-2LMN	96.864
					0.000	2.975	2	1.000	1.75		
120.000	D20	D20	SAE	45*45*5	275.0	47.18	18.32	D20P	15.426	b008-2LMN	84.182
					0.000	2.512	2	1.000	1.75		
120.000	D21	D21	SAE	45*45*5	275.0	75.48	65.55	D212XY	55.184	b010-3LMN	84.182
					0.000	1.286	2	1.000	1.75		
120.000	D22	D22	SAE	45*45*5	275.0	75.69	61.77	D222XY	51.999	b010-3LMN	84.182
					0.000	1.286	2	1.000	1.75		
120.000	D23	D23	SAE	50*50*5	275.0	86.43	67.87	D23XY	65.741	b009-3LMX	96.864
					0.000	2.869	2	1.000	1.75		
120.000	D24	D24	SAE	50*50*5	275.0	81.45	68.05	D24XY	65.918	b009-3LMX	96.864
					0.000	2.869	2	1.000	1.75		
120.000	D25	D25	SAE	45*45*5	275.0	30.77	14.59	D25P	12.279	b010-3LMN	84.182
					0.000	2.199	2	1.000	1.75		
120.000	D26	D26	SAE	45*45*5	275.0	36.26	16.11	D26P	12.28	b010-3LMN	84.182
					0.000	1.871	1	1.000	1.75		
60.000	49.200	49.200	SAE	45*45*5	275.0	50.19	50.19	D27X	24.694	b035-3RRSM	84.182
					0.000	1.871	1	1.000	1.75		
60.000	D28	D28	SAE	45*45*5	275.0	16.07	16.07	D28P	13.526	b009-3LMX	84.182
					0.000	2.121	2	1.000	1.75		
120.000	D30	D30	SAE	50*50*5	275.0	66.60	20.20	D30P	19.562	b009-3LMX	96.864
					0.000	6.834	2	1.000	1.75		
120.000	D31	D31	SAE	50*50*5	275.0	51.90	15.01	D31Y	14.535	b012-1RMN	96.864
					0.000	6.834	2	1.000	1.75		
120.000	D38	D38	SAE	50*50*5	275.0	64.02	28.77	D38Y	27.864	b011-1RMX	96.864
					0.000	7.271	2	1.000	1.75		
120.000	D39	D39	SAE	45*45*5	275.0	60.85	23.22	D39XY	19.546	b006-1LMN	84.182
					0.000	7.271	2	1.000	1.75		
120.000	D42	D42	SAE	55*55*5	275.0	80.59	27.90	D42Y	27.450	b017-NCLSM	108.826
					0.000	7.728	2	1.000	1.75		
120.000	D43	D43	SAE	50*50*5	275.0	52.83	14.27	D43XY	13.827	b006-1LMN	96.864
					0.000	7.728	2	1.000	1.75		
120.000	H1	H1	SAE	50*50*5	275.0	32.05	32.05	H1X	31.046	b001-NCMX	96.864
					0.000	2.000	2	1.000	1.75		
120.000	H2	H2	SAE	50*50*5	275.0	74.90	15.84	H2P	15.344	b006-1LMN	96.864
					0.000	2.000	2	1.000	1.75		
120.000	H3	H3	SAE	45*45*5	275.0	18.61	3.88	H3P	3.262	b012-1RMN	84.182
					0.000	0.973	2	1.000	1.75		
120.000	H4	H4	SAE	45*45*5	275.0	45.10	45.10	FH428P	37.966	b005-1LMX	84.182
					0.000	0.973	2	1.000	1.75		
120.000	H5	H5	SAE	50*50*5	275.0	20.01	20.01	H5X	19.384	b001-NCMX	96.864
					0.000	1.776	2	1.000	1.75		
120.000	H6	H6	SAE	50*50*5	275.0	67.01	23.07	H6P	22.342	b034-2RRSM	96.864
					0.000	1.776	2	1.000	1.75		
120.000	H7	H7	SAE	45*45*5	275.0	16.17	3.94	H7P	3.319	b014-2R MN	84.182
					0.000	0.862	2	1.000	1.75		
120.000	H8	H8	SAE	45*45*5	275.0	45.30	45.30	FH842P	38.131	b007-2LMX	84.182
					0.000	0.862	2	1.000	1.75		
120.000	H9	H9	SAE	50*50*5	275.0	18.29	18.29	H9X	17.720	b017-NCLSM	96.864



120.000	98.400	0.000	1.555	2	1.000	1.75			
H10	H10	SAE	50*50*5	275.0	93.48	20.58	H10P	19.932b036-3RRSM	96.864
120.000	98.400	0.000	1.555	2	1.000	1.75			
H11	H11	SAE	50*50*5	275.0	36.37	1.67	H11P	1.618b018-NCLSM	96.864
120.000	98.400	0.000	1.500	2	1.000	1.75			
H12	H12	SAE	50*50*5	275.0	31.72	31.72	H12P	30.721 b001-NCMX	96.864
120.000	98.400	0.000	1.500	2	1.000	1.75			
H13	H13	SAE	60*60*5	275.0	26.55	15.90	FH1372Y	15.643 b012-1RMN	120.750
120.000	98.400	0.000	3.258	2	1.000	1.75			
H14	H14	SAE	60*60*5	275.0	19.80	12.34	H14X	12.146 b005-1LMX	120.750
120.000	98.400	0.000	3.258	2	1.000	1.75			
H17	H17	SAE	60*60*5	275.0	39.83	17.81	FH1774Y	17.523b017-NCLSM	120.750
120.000	98.400	0.000	4.033	2	1.000	1.75			
H18	H18	SAE	60*60*5	275.0	20.26	9.01	H18P	8.869 b011-1RMX	120.750
120.000	98.400	0.000	4.033	2	1.000	1.75			
B1	B1	SAE	75*75*6	275.0	74.08	49.55	B1XY	58.511 b012-1RMN	188.305
120.000	118.080	0.000	3.391	2	1.000	1.75			
B2	B2	SAE	70*70*6	275.0	77.42	51.50	B2XY	60.808b014-2R MN	173.498
120.000	118.080	0.000	3.176	2	1.000	1.75			
B3	B3	SAE	60*60*6	355.0	83.26	48.85	B3XY	58.617b036-3RRSM	185.112
120.000	146.880	0.000	3.169	2	1.000	1.75			
T1	T1	SAE	50*50*5	275.0	44.73	43.22	T1Y	41.869 b005-1LMX	96.864
120.000	98.400	0.000	3.571	2	1.000	1.75			
T2	T2	SAE	45*45*5	275.0	57.74	49.82	T2Y	41.937 b007-2LMX	84.182
120.000	98.400	0.000	3.350	2	1.000	1.75			
T3	T3	SAE	45*45*5	275.0	59.34	59.34	T3Y	49.951 b009-3LMX	84.182
120.000	98.400	0.000	3.367	2	1.000	1.75			
P1	P1	SAE	50*50*6	275.0	42.38	35.03	P1XY	34.470b020-PKLSM	98.414
120.000	118.080	0.000	3.324	2	2.000	1.75			
M8	M8	SAE	100*100*7	355.0	81.75	67.21	M8X	264.473 b002-NCMN	393.528
720.000	514.080	0.000	3.050	6	2.000	1.75			
M10	M10	SAE	100*100*7	355.0	86.85	68.15	M10X	268.176 b002-NCMN	393.528
720.000	514.080	0.000	6.099	6	2.000	1.75			
M12	M12	SAE	100*100*8	355.0	83.01	63.57	M12X	284.010 b002-NCMN	446.778
720.000	587.520	0.000	6.099	6	2.000	1.75			
DUMM	DUMM	SAE	DUMMY	275.0	0.00	0.00	DUM1Y	0.107 b001-NCMX	1.176
120.000	5.904	0.000	4.100	2	1.000	1.75			



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*** Maximum Stress Summary for Each Load Case

Summary of Maximum Usages by Load Case:

Load Case	Maximum Usage %	Element Label	Element Type
b001-NCMX	89.45	M2P	Angle
b002-NCMN	83.96	M2Y	Angle
b003-PKMX	88.83	M6P	Angle
b004PKMN	80.70	M6P	Angle
b005-1LMX	85.90	D11X	Angle
b006-1LMN	85.84	D11X	Angle
b007-2LMX	84.71	D19Y	Angle
b008-2LMN	84.81	D19Y	Angle
b009-3LMX	93.48	H10Y	Angle
b010-3LMN	86.66	M61P	Angle
b011-1RMX	78.85	D13P	Angle
b012-1RMN	78.90	D13P	Angle
b013-2RMX	85.47	D19P	Angle
b014-2R MN	85.32	D19P	Angle
b015-3RMX	56.83	M2P	Angle
b016-3RMN	53.17	M2P	Angle
b017-NCLSMX	80.59	D42XY	Angle
b018-NCLSMN	74.43	D42XY	Angle
b019-PKLSMX	52.75	M61P	Angle
b020-PKLSMN	60.53	M61P	Angle
b021-1LLSMX	51.74	D42X	Angle
b022-1LLSMN	48.23	D42X	Angle

b023-2LLSMX	72.85	D42X	Angle
b024-2LLSMN	69.31	D42X	Angle
b025-3LLSMX	79.50	D23X	Angle
b026-3LLSMN	78.62	D23X	Angle
b027-NCRSMX	81.01	M6Y	Angle
b028-NCRSMN	66.48	D42XY	Angle
b029-PKRSMX	81.02	M6P	Angle
b030-PKRSMN	69.33	M6P	Angle
b031-1RRSMX	50.15	M6Y	Angle
b032-1RRSMN	43.49	D42XY	Angle
b033-2RRSMX	73.02	D171P	Angle
b034-2RRSMN	67.46	D19P	Angle
b035-3RRSMX	80.60	M6P	Angle
b036-3RRSMN	77.35	D23P	Angle

Summary of Insulator Usages:

Insulator Label	Insulator Type	Maximum Usage %	Load Case	Weight (N)
JA0	Clamp	2.78	b003-PKMX	0.0
CA0	Clamp	5.06	b005-1LMX	0.0
CB0	Clamp	5.06	b011-1RMX	0.0
CC0	Clamp	4.96	b007-2LMX	0.0
CD0	Clamp	4.96	b013-2RMX	0.0
CE0	Clamp	4.94	b009-3LMX	0.0
CF0	Clamp	4.56	b035-3RRSMX	0.0
AA0	Clamp	0.91	b002-NCMN	0.0
AA1	Clamp	0.91	b002-NCMN	0.0
AA2	Clamp	0.91	b002-NCMN	0.0
AA3	Clamp	0.91	b002-NCMN	0.0
XC0	Clamp	0.70	b002-NCMN	0.0
XC1	Clamp	0.70	b002-NCMN	0.0
XC2	Clamp	0.70	b002-NCMN	0.0
XC3	Clamp	0.70	b002-NCMN	0.0



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*** Weight of structure (N):
 Weight of Angles*Section DLF: 52794.0
 Total: 52794.0

*** End of Report

Appendix H

Tower analys with New conductor loads

Serial No.	Tower Type	Body Extension	Modification if any	Serial No.	Tower Type	Body Extension	Modification if any
1	TDT	3		61	TDL	3	
2	TD3	6		62	TDL	0	
3	TDL	6		63	TDL	3	
4	TDL	9		64	TDL	0	
5	TDL	3		65	TDL	0	
6	TDL	6		66	TDL	0	
7	TDL	6		67	TD1	3	
8	TDL	9		68	TDL	3	
9	TDL	3		69	TDL	0	
10	TD1spe	6	2 members to be changed	70	TDL	0	
11	TDL	6		71	TDL	0	
12	TDL	6		72	TDL	0	
13	TDL	0		73	TDL	0	
14	TDL	3		74	TDL	3	
15	TDL	6		75	TD3	0	2 members to be changed
16	TDL	0		76	TDL	0	
17	TDL	0		77	TDL	0	
18	TDL	0		78	TDL	6	
19	TDL	0		79	TD1sus	9	
20	TD6	0	4 members to be changed	80	TD1sus	9	
21	TDL	3		81	TDL	3	
22	TDL	0		82	TDL	0	
23	TDL	6		83	TDL	3	
24	TDL	9	1 member to be changed	84	TDL	3	
25	TDL	0		85	TDL	3	
26	TDL	3		86	TD1	3	
27	TDL	0		87	TDL	3	
28	TDL	6		88	TDL	0	
29	TD1	6		89	TDL	0	
30	TDL	3		90	TDL	0	
31	TDL	6		91	TDL	0	
32	TDL	0		92	TDL	0	
33	TDL	3		93	TDL	3	
34	TDL	6		94	TDL	6	3 members to be changed
35	TDL	3		95	TD1sus	9	
36	TDL	3		96	TD1	6	
37	TD1	0		97	TDL	3	
38	TDL	9		98	TDL	6	
39	TDL	6		99	TDL	0	
40	TDL	3		100	TDL	0	
41	TDL	0		101	TDL	0	
42	TDL	3		102	TDL	3	

43	TDL	3		103	TDL	3	
44	TDL	3		104	TDL	3	
45	TDL	0		105	TD6	0	
46	TDL	3		106	TDL	3	
47	TD1	0		107	TDL	3	
48	TDL	3		108	TDL	0	
49	TDL	0		109	TDL	3	
50	TDL	0		110	TDL	0	
51	TDL	3		111	TDL	0	
52	TDL	3		112	TDL	3	
53	TDL	0		113	TDL	0	
54	TDL	3		114	TDL	0	
55	TDL	0		115	TDL	3	
56	TDL	0		116	TDL	0	
57	TDL	0		117	TD1	0	
58	TDL	3		118	TDL	0	
59	TDL	3		119	TDL	0	
60	TD1	3		120	TDL	3	

Serial No.	Tower Type	Body Extension	Modification if any	Serial No.	Tower Type	Body Extension	Modification if any
121	TDL	0		181	TDL	0	
122	TDL	0		182	TDL	0	
123	TDL	0		183	TDL	0	
124	TDL	3		184	TDL	3	
125	TDL	3		185	TDL	0	
126	TDL	3		186	TDL	0	
127	TDL	3		187	TD1	0	
128	TDL	3		188	TDL	3	
129	TD3	0	4 members to be changed	189	TDL	0	
130	TDL	3		190	TDL	0	
131	TDL	3		191	TDL	0	
132	TDL	0		192	TDL	0	
133	TDL	0		193	TDL	0	
134	TDL	0		194	TDL	3	
135	TDL	0		195	TDL	0	
136	TDL	0		196	TDL	0	
137	TDL	3		197	TD1	0	
138	TD1	0		198	TDL	0	
139	TDL	0		199	TDL	0	
140	TDL	0		200	TDL	0	
141	TDL	3		201	TDL	3	
142	TDL	3		202	TDL	0	
143	TDL	3		203	TDL	0	
144	TDL	3		204	TDL	0	
145	TDL	3		205	TDL	0	
146	TDL	0		206	TD1	0	2 members to be changed
147	TDL	0		207	TDL	3	
148	TDL	0		208	TDL	0	
149	TD1	0		209	TDL	3	

150	TDL	3		210	TDL	0	
151	TDL	0		211	TDL	0	
152	TDL	0		212	TDL	3	
153	TDL	3		213	TDL	0	
154	TDL	0		214	TDL	0	
155	TDL	3		215	TDL	0	
156	TDL	3		216	TDL	0	
157	TDL	0		217	TD1	0	
158	TDL	0		218	TDL	0	
159	TD1	0		219	TDL	3	
160	TDL	0		220	TDL	3	
161	TDL	3		221	TDL	3	
162	TDL	3		222	TDL	0	
163	TDL	0		223	TDL	0	
164	TDL	0		224	TDL	3	
165	TDL	0		225	TDL	6	
166	TDL	0		226	TDL	3	
167	TD3	0	1 member to be changed	227	TDL	0	
168	TDL	0		228	TD3	0	
169	TDL	0		229	TD1	0	
170	TDL	3		230	TDL	3	
171	TDL	0		231	TD1spe	0	
172	TDL	0		232	TD3	0	
173	TDL	0		233	TDL	6	
174	TDL	3		234	TDL	3	
175	TDL	0		235	TDL	3	
176	TDL	0		236	TD6	3	
177	TD1	0	1 member to be changed	237	TDL	6	3 members to be changed
178	TDL	0		238	TDT	0	
179	TDL	0					
180	TDL	3					



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Appendix I

i. Angle Tower (TD3)

Angle of Deviation (Degree)	Wind Span (m)	
	Conductor	Earthwire
11	958.8	1003.3
12	926.9	969.0
13	895.0	934.8
14	863.2	900.6
15	831.4	866.4
16	799.6	832.3
17	767.9	798.2
18	736.2	764.2
19	704.5	730.2
20	672.9	696.2
21	641.4	662.3
22	609.9	628.5
23	578.4	594.7
24	547.0	561.0
25	515.7	527.3
26	484.4	493.7
27	453.2	460.2
28	422.1	426.7
29	391.0	393.3
30	360.0	360.0
31	329.1	326.8
32	298.2	293.6
33	267.4	260.5
34	236.7	227.6
35	206.1	194.7


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36	175.6	161.8
37	145.1	129.1
38	114.8	96.5
39	84.5	64.0
40	54.3	31.6

iv. Angle Tower (TD6)

Angle of Deviation Degree	Wind Span (m)	
	Conductor	Earthwire
40	940.4	983.6
41	910.4	951.3
42	880.4	919.1
43	850.5	887.0
44	820.7	855.0
45	791.0	823.1
46	761.5	791.3
47	732.0	759.7
48	702.7	728.1
49	673.4	696.7
50	644.3	665.5
51	615.3	634.3
52	586.4	603.3
53	557.7	572.4
54	529.0	541.6
55	500.5	511.0
56	472.2	480.5
57	443.9	450.2
58	415.8	420.0



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59	387.8	389.9
60	360.0	360.0
61	332.3	330.2
62	304.7	300.6
63	277.3	271.2
64	250.1	241.9
65	223.0	212.8
66	196.0	183.8
67	169.2	155.0
68	142.5	126.3
69	116.0	97.9
70	89.7	69.6

v. Angle Tower (TDT)

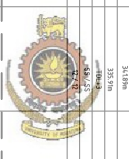
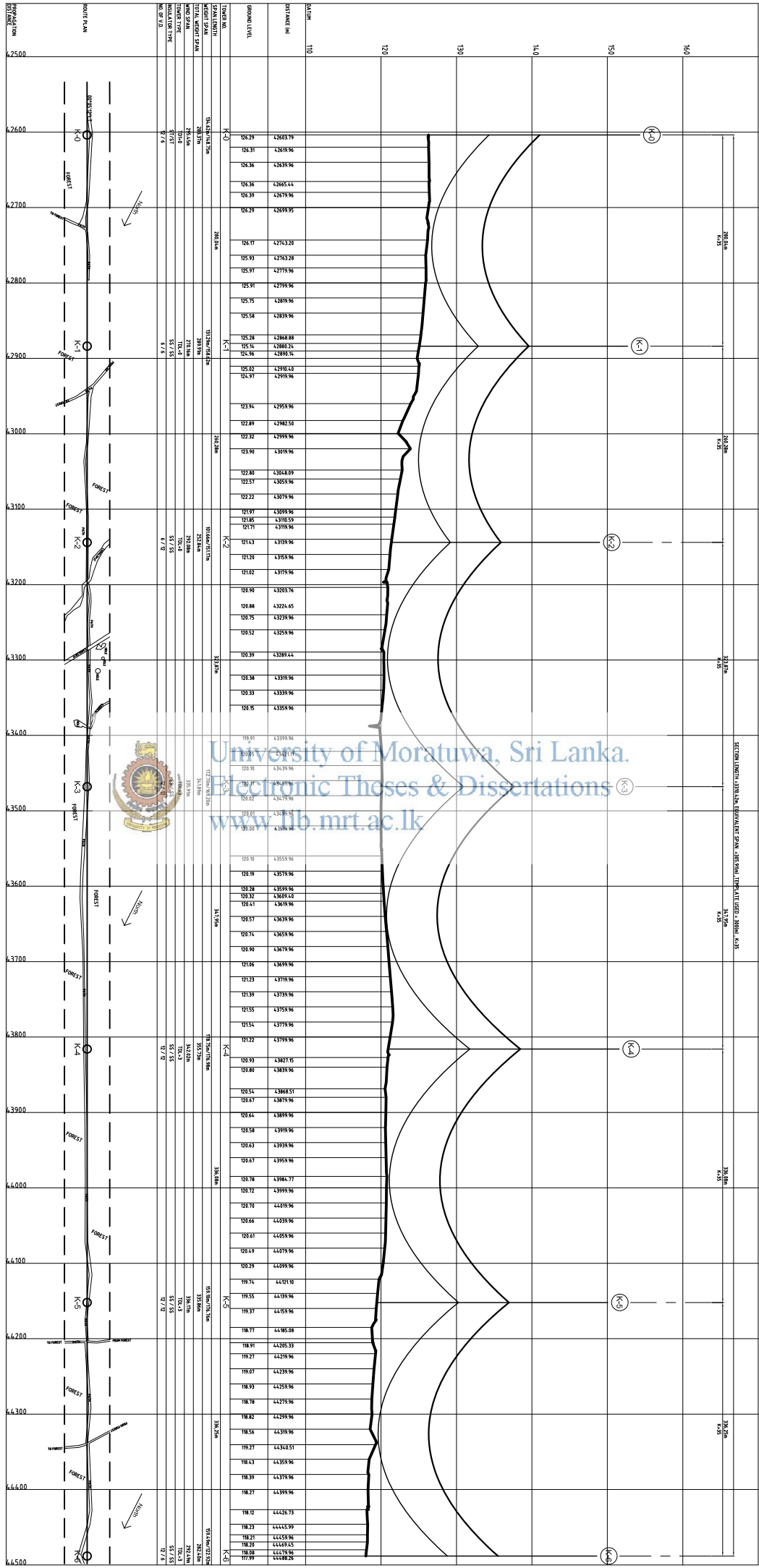
Angle of Deviation (Degree)	Wind Span (m)	
	Conductor	Earthwire
75	721.3	748.2
76	696.0	721.0
77	670.8	693.9
78	645.8	667.1
79	621.0	640.4
80	596.3	613.9
81	571.8	587.6
82	547.6	561.5
83	523.5	535.6
84	499.5	509.9
85	475.8	484.4
86	452.3	459.1
87	428.9	434.0

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88	405.7	409.1
89	382.8	384.5
90	360.0	360.0
91	337.4	335.7
92	315.1	311.7
93	292.9	287.9
94	270.9	264.3
95	249.1	240.9
96	227.6	217.7
97	206.2	194.8
98	185.1	172.1
99	164.2	149.6
100	143.5	127.3



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