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APPENDIX A: Sample Current Carrying Capacity Calculation

ACSR Zebra conductor

Finding out CCC of Zebra conductor at the operating temperature 60°C

Heat Balance Equation

$$P_j + P_{sol} = P_{rad} + P_{conv}$$

P_j = heat generated by joule effect

P_{sol} = solar heat gain by conductor surface

P_{rad} = heat loss by radiation

P_{conv} = convection heat loss

Solar heat gain

$$P_{sol} = \gamma D S_i$$

γ = Solar radiation absorption coefficient (0.5)

D = Conductor Diameter (0.02862m)

S_i = intensity of solar radiation (1000W/m^2)

$$P_{sol} = 0.5 \times 0.02862 \times 1000$$

P_{sol} = 14.31 W/m

Radiated heat loss

$$P_{rad} = s\pi D K_e (T_2^4 - T_1^4)$$

S = Stefan-Boltzmann constant (5.67 x 10^{-8} W/m^{2}k^4)

D = conductor diameter (0.02862m)

K_e = emissivity coefficient (0.5)

T_2 = final equilibrium temperature (60°C)

T_1 = ambient temperature (32°C)

$$P_{rad} = 5.67 \times 10^{-8} \times \pi \times 0.02862 \times 0.5(333^4 - 305^4)$$

P_{rad} = 9.2854 W/m

Reynolds Number

$$R_e = 1.644 \times 10^9 vD[T_1 + 0.5(T_2 - T_1)]^{-1.78}$$

R_e = Reynolds number

V = wind speed (0.5 m/s)

D = conductor diameter (0.02862m)

T_1 = ambient temperature (32°C)

T_2 = final equilibrium temperature (75°C)

$$R_e = 1.644 \times 10^9 \times 0.5 \times 0.02862[305 + 0.5(333 - 305)]^{-1.78}$$

R_e = 821.85

Nusselt number

$$N_u = 0.65R_e^{0.2} + 0.23R_e^{0.61}$$

Nu = Nusselt Number

Re = Reynolds Number

$$N_u = 0.65 \times 882.46^{0.2} + 0.23 \times 882.46^{0.61}$$

N_u = 16.284

Convection heat lost

$$P_{conv} = \lambda N_u (T_2 - T_1)\pi$$

λ = Thermal conductivity of air (0.02585 W/m.k)

$$P_{conv} = 0.02585 \times 16.284(333 - 305)\pi$$

P_{conv} = 37.0282W/m

AC Resistance

$$\boldsymbol{R(T_C) = \left[\frac{R(T_{high}) - R(T_{low})}{T_{high} - T_{low}}\right](T_c - T_{low}) + R(T_{low})}$$

$R(T_{high})$ = resistance at 75°C (0.08149Ω/m)

$R(T_{low})$ = resistance at 25°C (0.06841Ω/m)

T_c = conductor operating temperature (60°C)

$$\boldsymbol{R(T_{50}) = \left[\frac{0.08149 - 0.06841}{75 - 25}\right](60 - 25) + 0.06841}$$

$R(T_{50})$ = 0.077566Ω/m

Joule Effect

$$P_j = R_T I^2$$

$$I = \left[\frac{P_{rad} + P_{conv} - P_{sol}}{R_t}\right]^{\frac{1}{2}}$$

$$I = \left[\frac{9.2854 + 37.0282 - 14.31}{0.077566 \times 10^{-3}}\right]^{\frac{1}{2}}$$

I = 624A

APPENDIX B: Sag Tension Calculation

Conductor Properties

Conductor diameter (d)	mm	28.62
Cross section (A)	mm^2	484.5
Unit Weight (m_c)	kg/m	1.632
UTS	kN	131.9
Coefficient of Linear Ex. (α)	$°C^{-1}$	0.0000193
Modulus of Elasticity (E)	N/mm^2	69000

Other Data

Span	m	300
Minimum Temperature	°C	7
Everyday Temperature	°C	32
Maximum Temperature	°C	75
Wind Pressure (P)	N/m^2	970
Factor of Safety at stringent condition		2.5
Factor of Safety at Everyday condition		4.5

Wind load factor on conductor at stringent condition

$$q = \frac{\sqrt{(P.d)^2+(m_c g)^2}}{m_c g}$$

$$q_1 = \frac{\sqrt{(970\times0.02862)^2+(1.632\times9.80665)^2}}{(1.632\times9.80665)}$$

$$q_1 = 2.0022$$

Wind load factor at EDS condition

$$q_2 = \frac{\sqrt{(0\times0.02862)^2+(1.632\times9.80665)^2}}{(1.632\times9.80665)}$$

$$q_2 = 1$$

Maximum allowable working tension = UTS/2.5

= 131.9/2.5 = 52.76kN

Maximum allowable working stress (H_1) = $\frac{52760}{2.5} = 108.9N/mm^2$

Weight of conductor /m/mm^2 (δ)

$$\delta = \frac{m_c g}{A}$$

$$\delta = \frac{1.632 \times 9.80665}{484.5}$$

$$\delta = 0.03303$$

To find tension at Everyday condition; State Change Equation is used;

$$H_2^2[H_2 - \left[H_1 - \left(\frac{S^2\delta^2 Q_1^2 E}{24H_1^2}\right) - \alpha.E.(t_2 - t_1)\right]] = \frac{L^2\mu^2 Q_2^2 E}{24}$$

$$H_2^2[H_2 - \left[108.9 - \left(\frac{300^2 \times 0.03303^2 \times 2.022^2 \times 69000}{24 \times 108.9^2}\right) - 0.0000193 \times 69000.(32 - 7)\right]$$
$$= \frac{300^2 \times 0.03303^2 \times 1 \times 69000}{24}$$

From Newton Raphson Method;

100	73.0309	26.9691
73.0309	61.75963	11.27127
61.75963	59.67795	2.081686
59.67795	59.61054	0.067407
59.61054	59.61047	6.93E-05
59.61047	59.61047	7.33E-11

59.61047	59.61047	0
59.61047	59.61047	0
59.61047	59.61047	0

Tension at EDS condition (H_2) = 59.61 N/mm^2

= 59.61 x 484.5 = 28,881N

Safety Factor @ = $\frac{131,900}{28,881}$ = 4.56 (>4.5)

Safety factor is satisfied

Catenary Constant = $\frac{131,900}{4.56 \times 1.632 \times 9.80665}$

= 1807m

Final Tension at Maximum Operating Temperature;

$$H_2^2\left[H_2 - 108.9 - \left(\frac{300^2 \times 0.03303^2 \times 2.022^2 \times 69000}{24 \times 108.9^2}\right) - 0.0000193 \times 69000.(75-7)\right]$$

$$= \frac{300^2 \times 0.03303^2 \times 1 \times 69000}{24}$$

H_2 at 75°C = 47.58N/mm^2

= 23,055N

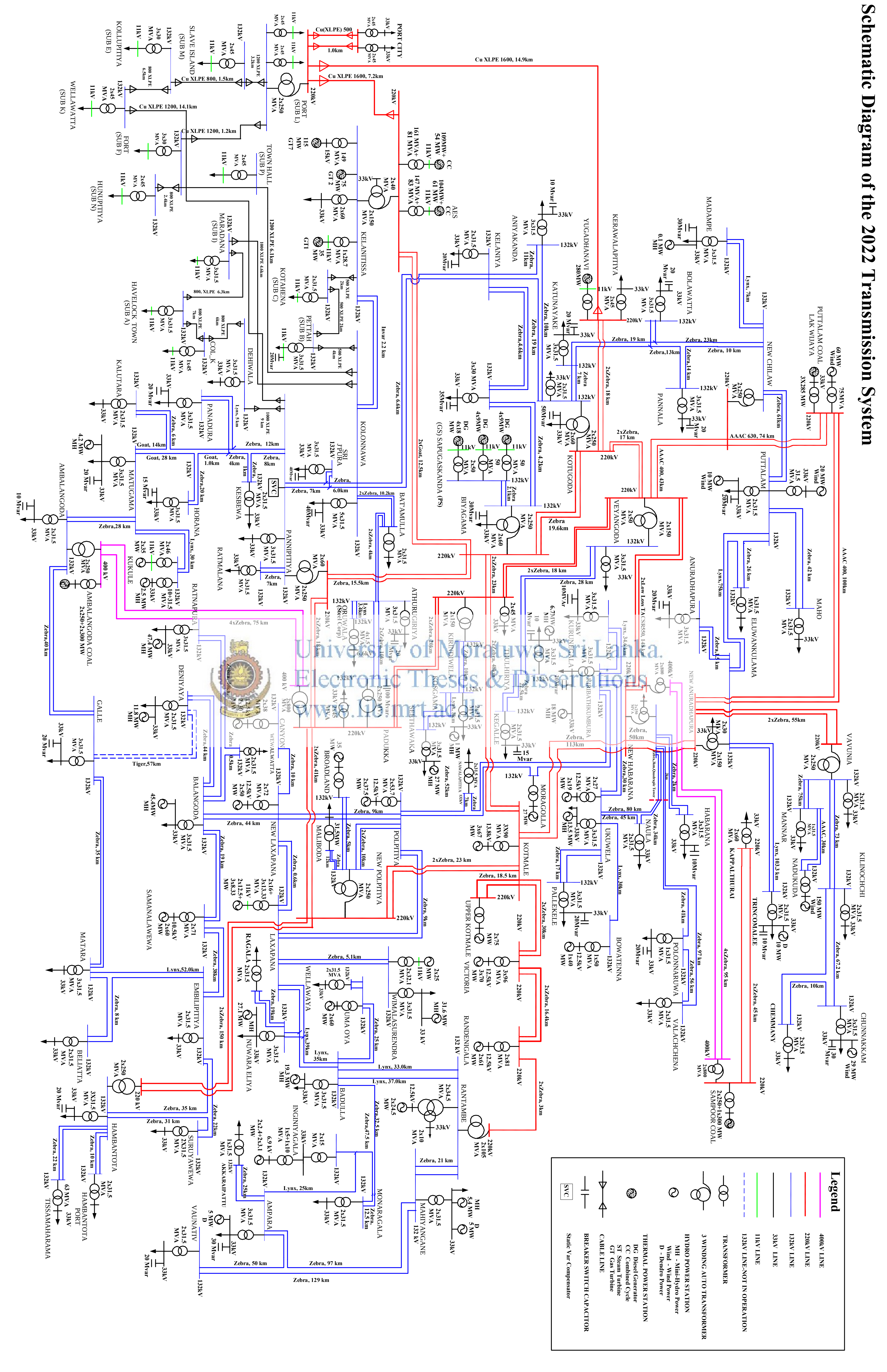
Sag at maximum Operating Temperature;

$$Sag\ (m) = \frac{L^2 \mu Q_2}{8H_2}$$

$$Sag\ (m) = \frac{300^2 \times 0.03303 \times 1}{8 \times 23,055}$$

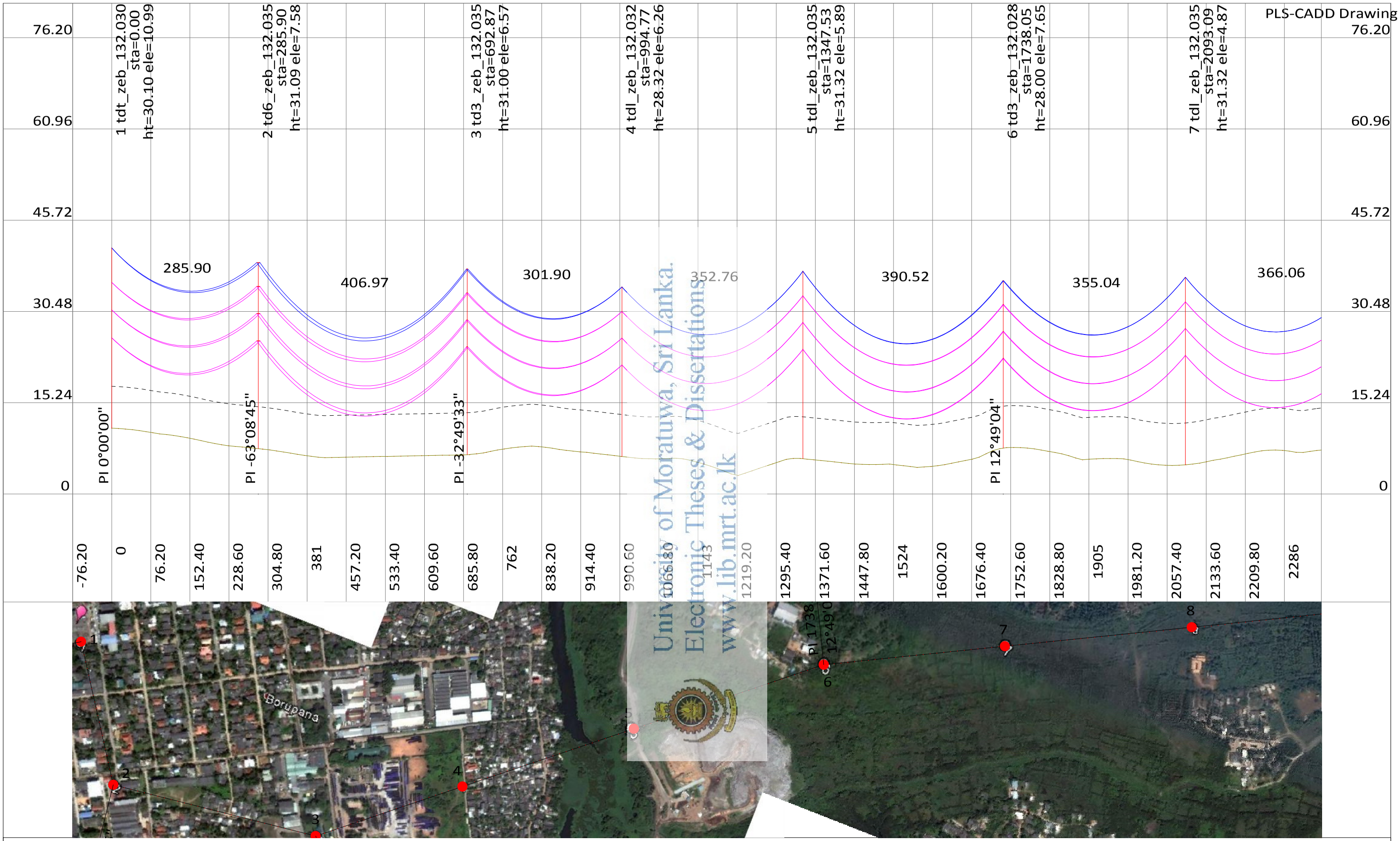
$$Sag\ (m) = 7.8097\text{m}$$

APPENDIX C: SINGLE LINE DIAGRAM OF SRI LANKA'S TRANSMISSION SYSTEM



APPENDIX D: **PLS CADD Design of Pannipitiya Rathmalana Line**

- Profile View of Panninpitiya – Ratmalana 132kV Existing Lynx Transmission Line
- Summary Data Sheet
- EMF Calculations



70.0 m Horiz. Scale

6.0 m Vert. Scale

North

Pannipitiya-Ratmalana 132kV Single Lynx, Double Circuit

Transmission Line - Profile/ Plan View

PLS-CADD Drawing

76.20
60.96
45.72
30.48
15.24
0

8 tdl_zeb_132.035 sta=2459.15 ht=31.32 ele=6.56
9 tdl_zeb_132.032 sta=2800.42 ht=28.32 ele=6.26
10 tdl_zeb_132.035 sta=3159.57 ht=31.32 ele=6.81
11 tdl_zeb_132.035 sta=3552.31 ht=31.32 ele=5.80
12 tdl_zeb_132.032 sta=3907.16 ht=28.32 ele=5.55
13 tdl_zeb_132.032 sta=4233.82 ht=28.32 ele=8.84
14 tdl_zeb_132.035 sta=4555.79 ht=31.32 ele=5.42

341.27 359.15 392.73 354.85 326.66 321.97

2286 2362.20 2438.40 2514.60 2590.80 2667 2743.20 2819.40 2895.60 2971.80 3048 3124.20 3200.40 3276.60 3352.80 3429 3505.26 3581.40 3657.60 3733.80 3810 3886.20 3962.40 4038.60 4114.80 4191 4267.20 4343.40 4419.60 4495.80 4572 4648.20

70.0 m Horiz. Scale

6.0 m Vert. Scale

North

Pannipitiya-Ratmalana 132kV Single Lynx, Double Circuit

Transmission Line - Profile/ Plan View

PLS-CADD Drawing

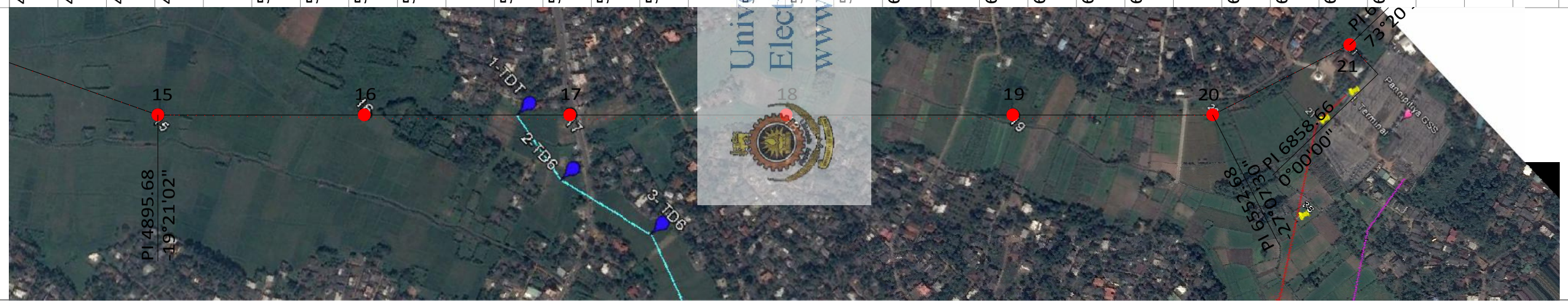
76.20
60.96
45.72
30.48
15.24
0

15 td3_zeb_132.028 sta=4895.68 ht=28.00 ele=5.33
16 tdl_zeb_132.032 sta=5219.96 ht=28.32 ele=6.05
17 tdl_zeb_132.032 sta=5542.59 ht=28.32 ele=7.69
18 tdl_zeb_132.032 sta=5882.54 ht=28.32 ele=9.43
19 tdl_zeb_132.035 sta=6238.68 ht=31.32 ele=11.25
20 td3_zeb_132.028 sta=6552.68 ht=28.00 ele=11.86
21 tdt_zeb_132.030 sta=6794.77 ht=30.10 ele=14.76

339.89
324.27
322.63
339.95
356.14
313.99
242.09

PI -19°21'02"
PI -27°07'30"
PI 73°20'17"
PI 0°00'00"

4648.20 4724.40 4800.60 4876.80 4953 5029.20 5105.40 5181.60 5257.80 5334 5410.20 5486.40 5562.60 5638.80 5715 5791.20 5867.40 5943.60 6019.80 6096 6172.20 6248.40 6324.60 6400.80 6477 6553.20 6629.40 6705.60 6781.80 6858



70.0 m Horiz. Scale

6.0 m Vert. Scale

North

Pannipitiya-Ratmalana 132kV Single Lynx, Double Circuit

Transmission Line - Profile/ Plan View

PLS-CADD Version 13.20x64 2:28:46 PM Friday, March 27, 2015
Ceylon Electricity Board - Transmission Design
Project Name: 'f:\msc\pls cadd simulations\pannipitiya- panadura transmission line
\panni_rath_lynx\pannipitiya ratmalana line.DON'

Line Statistics:
  Total line length: 6.79 (km)

  Total number of sections: 3
  Longest section by linear length: 6.79 (km)
  Longest section by number of structures: 21 structures

  Total number of structures used: 21
  Average number of structures per Km: 3.09

  Total number of line angles: 6
  Average number of line angles per Km: 0.88
  Number of <= 1 deg line angles: 0
  Number of <= 5 deg line angles: 0
  Number of <= 15 deg line angles: 1
  Number of <= 30 deg line angles: 2
  Number of <= 90 deg line angles: 3
  Number of > 90 deg line angles: 0

  Total number of deadend structures: 2
  Average number of deadend structures per Km: 0.29
  Maximum number of suspension structures between deadend structures: 19
  Average number of suspension structures between deadend structures: 9.50

Structure List Report

Struct. Number	Station (m)	Line Angle (deg)	Ahead Span (m)	Height Adjust (m)	Offset Adjust (m)	Orient Angle (deg)	Name/Description/Comments/Material
1	0.00	0.00	285.90	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdt_zeb_132.030
							TDT
2	285.90	-63.15	406.97	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\structures\td6_zeb_132.035
							TD6
							embed len=3.00
3	692.87	-32.83	301.90	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\structures\td3_zeb_132.035
							TD3
							embed len=3.00
4	994.77	0.00	352.76	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.032
							TDL+0
5	1347.53	0.00	390.52	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.035
							TDL+0
							embed len=0.15
6	1738.05	12.82	355.04	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\td3_zeb_132.028
							TD3
7	2093.09	0.00	366.06	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.035
							TDL+0
							embed len=0.15
8	2459.15	0.00	341.27	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.035
							TDL+0
							embed len=0.15
9	2800.42	0.00	359.15	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.032
							TDL+0
10	3159.57	0.00	392.73	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.035
							TDL+0
							embed len=0.15
11	3552.31	0.00	354.85	0.00	0.00	0.00	f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.035

TDL+0
embed len=0.15
12 3907.16 0.00 326.66 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.032
TDL+0
13 4233.82 0.00 321.97 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.032
TDL+0
14 4555.79 0.00 339.89 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.035
TDL+0
embed len=0.15
15 4895.68 -19.35 324.27 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\td3_zeb_132.028
TD3
16 5219.96 0.00 322.63 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.032
TDL+0
17 5542.59 0.00 339.95 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.032
TDL+0
18 5882.54 0.00 356.14 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.032
TDL+0
19 6238.68 0.00 313.99 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\tdl_zeb_132.035
TDL+0
embed len=0.15
20 6552.68 -27.12 242.09 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\panni_rath_lynx\structures\td3_zeb_132.028
TD3
21 6794.77 73.34 0.00 0.00 0.00 0.00 f:\msc\pls cadd simulations\pannipitiya-panadura transmission line\structures\tdt_zeb_132.030
TDT

Structure Coordinates Report

Struct. Number	Station (m)	Ahead Span (m)	X (m)	Y (m)	Z (m)	Structure Name
1	0.00	285.90	377497.75	753280.32	10.99	tdt_zeb_132.030
2	285.90	406.97	377657.94	753043.51	7.58	td6_zeb_132.035
3	692.87	301.90	378061.68	753094.68	6.57	td3_zeb_132.035
4	994.77	352.76	378292.79	753288.94	6.26	tdl_zeb_132.032
5	1347.53	390.52	378562.82	753515.91	5.89	tdl_zeb_132.035
6	1738.05	355.04	378861.76	753767.19	7.65	td3_zeb_132.028
7	2093.09	366.06	379177.45	753929.65	4.87	tdl_zeb_132.035
8	2459.15	341.27	379502.94	754097.15	6.56	tdl_zeb_132.035
9	2800.42	359.15	379806.39	754253.31	6.26	tdl_zeb_132.032
10	3159.57	392.73	380125.74	754417.65	6.81	tdl_zeb_132.035
11	3552.31	354.85	380474.95	754597.35	5.80	tdl_zeb_132.035
12	3907.16	326.66	380790.47	754759.72	5.55	tdl_zeb_132.032
13	4233.82	321.97	381080.93	754909.20	8.84	tdl_zeb_132.032
14	4555.79	339.89	381367.22	755056.52	5.12	tdl_zeb_132.035
15	4895.68	324.27	381669.44	755212.05	5.33	td3_zeb_132.028
16	5219.96	322.63	381892.32	755447.59	6.05	tdl_zeb_132.032
17	5542.59	339.95	382114.07	755681.93	7.69	tdl_zeb_132.032
18	5882.54	356.14	382347.73	755928.86	9.43	tdl_zeb_132.032
19	6238.68	313.99	382592.51	756187.54	11.25	tdl_zeb_132.035
20	6552.68	242.09	382808.33	756415.61	11.86	td3_zeb_132.028
21	6794.77	0.00	382876.25	756647.97	14.76	tdt_zeb_132.030

Structure Attachment Coordinates

Coordinates and arc lengths along the wire are for weather case 'EDS', Creep RS, wind from the left.
Arc lengths are adjusted for the number of subconductors and to exclude the length of strain insulators.
Arc lengths and slack are computed with any concentrated loads removed. Other columns are with concentrated loads applied.

Struct. Set Phase Structure Set ---------Insulator-------- | -----------

```
Wire---------- | ------------Mid---------- | ------------Low---------- | -----TIN Z below----
|   Ahead   Ahead
 Number No.   No.            Name   Label ----------Attach---------- | ----------
Attach---------- | ----------Span---------- | ----------Point---------- |Insulator  Mid
Low |    Span    Span
                                          ----------Point---------- | ----------
Point---------- | ----------Point---------- |                           | Attach   Span  Point
|     Arc   Slack
                                                 X         Y      Z |         X         Y
Z |         X         Y      Z |         X         Y      Z | ---Point-----         |  Length
                                          ------------(m)---------- | ------------
(m)---------- | ------------(m)---------- | ------------(m)---------- | ---------(m)--------
|     (m)     (m)
-------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------
----
      1   1     1 tdt_zeb_132.030      GW 377502.29 753283.39  41.09   377502.29 753283.39
41.09   377581.27 753166.00  34.61   377590.36 753152.49  34.54     0.00   0.00   0.00   283.239
0.261
                2                          377493.20 753277.24  41.09   377493.20 753277.24
41.09   377574.42 753157.83  34.39   377583.39 753144.63  34.32     0.00   0.00   0.00   289.119
0.278
          2     1                        C1 377502.14 753283.29  35.34   377503.34 753281.51
35.20   377581.19 753165.95  30.34   377584.05 753161.71  30.33     0.00   0.00   0.00   278.873
0.205
                2                          377502.72 753283.68  30.74   377503.91 753281.90
30.60   377581.48 753166.15  25.78   377584.01 753162.37  25.77     0.00   0.00   0.00   278.875
0.205
                3                          377503.38 753284.13  26.09   377504.57 753282.34
25.95   377581.92 753166.61  21.17   377584.10 753163.35  21.17     0.00   0.00   0.00   278.598
0.205
          3     1                        C2 377493.36 753277.35  35.34   377494.56 753275.57
35.20   377574.49 753157.88  30.14   377577.31 753153.73  30.13     0.00   0.00   0.00   284.750
0.218
                2                          377492.78 753276.96  30.74   377493.99 753275.18
30.60   377574.20 753157.68  25.58   377576.70 753154.03  25.58     0.00   0.00   0.00   284.752
0.218
                3                          377492.12 753276.51  26.09   377493.33 753274.74
25.95   377573.76 753157.22  20.96   377575.93 753154.05  20.96     0.00   0.00   0.00   285.031
0.219

      2   1     1 td6_zeb_132.035      GW 377660.25 753048.61  38.67   377660.25 753048.61
38.67   377860.06 753073.71  27.44   377865.17 753074.35  27.43     7.58   0.00   0.00   403.525
0.754
                2                          377655.63 753038.41  38.67   377655.63 753038.41
38.67   377859.56 753064.49  26.99   377864.57 753065.13  26.98     0.00   0.00   0.00   411.980
0.802
          2     1                        C1 377660.25 753048.61  34.67   377662.37 753048.88
34.46   377860.06 753073.71  24.66   377865.84 753074.44  24.65     7.58   0.00   0.00   399.063
0.592
                2                          377660.25 753048.61  30.15   377662.37 753048.88
29.94   377860.04 753073.76  20.15   377865.70 753074.47  20.14     7.58   0.00   0.00   399.034
0.592
                3                          377660.47 753049.10  25.58   377662.59 753049.36
25.37   377860.07 753074.18  15.63   377865.36 753074.85  15.62     7.58   0.00   0.00   398.642
0.590
          3     1                        C2 377655.63 753038.41  34.67   377657.75 753038.68
34.46   377859.56 753064.49  24.26   377865.21 753065.21  24.25     0.00   0.00   0.00   407.508
0.630
                2                          377655.63 753038.41  30.15   377657.75 753038.68
29.94   377859.58 753064.44  19.74   377865.13 753065.15  19.74     0.00   0.00   0.00   407.536
0.630
                3                          377655.41 753037.93  25.58   377657.53 753038.20
25.37   377859.55 753064.02  15.19   377864.74 753064.68  15.18     0.00   0.00   0.00   407.928
0.632

      3   1     1 td3_zeb_132.035      GW 378059.88 753098.80  37.57   378059.88 753098.80
37.57   378175.06 753195.38  30.13   378189.50 753207.49  30.04     6.61   0.00   0.00   300.957
0.314
                2                          378063.49 753090.56  37.57   378063.49 753090.56
37.57   378179.41 753188.24  30.03   378193.71 753200.29  29.94     0.00   0.00   0.00   303.508
0.322
          2     1                        C1 378059.88 753098.80  33.57   378061.52 753100.18
33.40   378175.88 753196.08  26.75   378191.91 753209.53  26.64     6.61   0.00   0.00   298.740
0.246
                2                          378059.84 753098.90  29.07   378061.48 753100.27
28.90   378175.83 753196.15  22.27   378191.59 753209.37  22.17     6.61   0.00   0.00   298.712
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0.246
             3                          378059.68 753099.26  24.57   378061.32 753100.64
24.40   378175.65 753196.45  17.78   378191.41 753209.66  17.68     6.61   0.00   0.00   298.599
0.246
          3     1                        C2 378063.49 753090.56  33.57   378065.12 753091.94
33.40   378180.23 753188.92  26.66   378196.10 753202.28  26.56     0.00   0.00   0.00   301.290
0.253
             2                          378063.53 753090.47  29.07   378065.16 753091.85
28.90   378180.27 753188.85  22.18   378195.86 753201.98  22.08     0.00   0.00   0.00   301.318
0.253
             3                          378063.69 753090.10  24.57   378065.32 753091.48
24.40   378180.46 753188.54  17.68   378196.04 753201.68  17.58     0.00   0.00   0.00   301.431
0.253

       4   1     1 tdl_zeb_132.032      GW 378290.24 753291.96  34.58   378290.24 753291.96
34.58   378425.26 753405.45  27.71   378414.44 753396.35  27.65     0.00   0.00   0.00   353.272
0.507
             2                          378295.33 753285.91  34.58   378295.33 753285.91
34.58   378430.34 753399.40  27.71   378419.52 753390.31  27.65     0.00   0.00   0.00   353.272
0.507
          2     1                        P1 378290.24 753291.96  32.63   378290.23 753291.97
30.48   378425.25 753405.46  24.54   378413.04 753395.20  24.48     0.00   0.00   0.00   353.164
0.398
             2                          378290.20 753292.01  28.18   378290.19 753292.03
26.03   378425.20 753405.52  20.09   378413.00 753395.26  20.03     0.00   0.00   0.00   353.164
0.398
             3                          378290.00 753292.25  23.68   378289.98 753292.27
21.53   378425.00 753405.76  15.59   378412.80 753395.50  15.53     0.00   0.00   0.00   353.164
0.398
          3     1                        378295.33 753285.91  32.63   378295.34 753285.90
30.48   378430.35 753399.39  24.54   378418.15 753389.13  24.48     0.00   0.00   0.00   353.164
0.398
             2                          378295.37 753285.86  28.18   378295.38 753285.84
26.03   378430.40 753399.33  20.09   378418.20 753389.07  20.03     0.00   0.00   0.00   353.164
0.398
             3                          378295.57 753285.62  23.68   378295.59 753285.60
21.53   378430.60 753399.09  15.59   378418.40 753388.83  15.53     0.00   0.00   0.00   353.164
0.398

       5   1     1 tdl_zeb_132.035      GW 378560.28 753518.94  37.21   378560.28 753518.94
37.21   378709.77 753644.94  26.37   378715.55 753649.80  26.35     0.00   0.00   0.00   391.717
0.690
             2                          378565.36 753512.89  37.21   378565.36 753512.89
37.21   378714.81 753638.17  26.42   378720.62 753643.04  26.40     0.00   0.00   0.00   390.707
0.685
          2     1                        P1 378560.28 753518.94  35.26   378560.27 753518.95
33.11   378708.95 753644.25  23.47   378715.87 753650.09  23.45     0.00   0.00   0.00   389.419
0.542
             2                          378560.23 753518.99  30.81   378560.22 753519.00
28.66   378708.90 753644.32  18.99   378716.02 753650.33  18.97     0.00   0.00   0.00   389.430
0.542
             3                          378560.03 753519.23  26.31   378560.02 753519.24
24.16   378708.69 753644.61  14.49   378715.81 753650.61  14.47     0.00   0.00   0.00   389.475
0.542
          3     1                        378565.36 753512.89  35.26   378565.37 753512.88
33.11   378713.99 753637.47  23.51   378720.95 753643.30  23.49     0.00   0.00   0.00   388.410
0.538
             2                          378565.41 753512.84  30.81   378565.42 753512.82
28.66   378714.04 753637.40  19.04   378721.20 753643.40  19.02     0.00   0.00   0.00   388.399
0.538
             3                          378565.61 753512.60  26.31   378565.62 753512.58
24.16   378714.25 753637.12  14.54   378721.41 753643.11  14.52     0.00   0.00   0.00   388.354
0.538

       6   1     1 td3_zeb_132.028      GW 378859.27 753770.94  35.65   378859.27 753770.94
35.65   379017.46 753852.05  27.60   379014.90 753850.74  27.60     0.00   0.00   0.00   356.061
0.519
             2                          378864.26 753763.44  35.65   378864.26 753763.44
35.65   379021.76 753844.79  27.65   379019.21 753843.47  27.65     7.16   0.00   0.00   355.052
0.514
          2     1                        C1 378859.27 753770.94  31.65   378861.18 753771.91
31.48   379018.41 753852.55  24.50   379015.11 753850.86  24.50     0.00   0.00   0.00   353.800
0.407
             2                          378859.21 753771.02  27.15   378861.12 753772.00
26.98   379018.36 753852.62  20.02   379014.80 753850.79  20.02     0.00   0.00   0.00   353.811
0.407
             3                          378858.99 753771.35  22.65   378860.90 753772.33
22.48   379018.18 753852.92  15.52   379014.62 753851.10  15.52     0.00   0.00   0.00   353.856
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0.408
         3     1                       C2 378864.26 753763.44  31.65   378866.16 753764.43
31.48   379022.71 753845.27  24.54   379019.42 753843.57  24.54     7.16   0.00   0.00   352.792
0.404
               2                          378864.31 753763.36  27.15   378866.21 753764.34
26.98   379022.76 753845.20  20.07   379019.19 753843.36  20.06     7.14   0.00   0.00   352.781
0.404
               3                          378864.53 753763.03  22.65   378866.44 753764.01
22.48   379022.94 753844.89  15.57   379019.38 753843.05  15.57     0.00   0.00   0.00   352.736
0.404

      7   1     1 tdl_zeb_132.035       GW 379175.65 753933.16  36.19   379175.65 753933.16
36.19   379338.39 754016.91  28.21   379330.59 754012.90  28.19     0.00   0.00   0.00   366.631
0.566
               2                          379179.26 753926.14  36.19   379179.26 753926.14
36.19   379342.01 754009.89  28.21   379334.21 754005.87  28.19     0.00   0.00   0.00   366.631
0.566
         2     1                       P1 379175.65 753933.16  34.24   379175.64 753933.18
32.09   379338.39 754016.92  25.12   379329.60 754012.40  25.10     0.00   0.00   0.00   366.509
0.445
               2                          379175.61 753933.22  29.79   379175.60 753933.24
27.64   379338.35 754016.98  20.67   379329.56 754012.46  20.65     0.00   0.00   0.00   366.509
0.445
               3                          379175.47 753933.50  25.29   379175.46 753933.52
23.14   379338.21 754017.26  16.17   379329.42 754012.74  16.15     0.00   0.00   0.00   366.509
0.445
         3     1                          379179.26 753926.14  34.24   379179.27 753926.12
32.09   379342.01 754009.88  25.12   379333.22 754005.35  25.10     0.00   0.00   0.00   366.509
0.445
               2                          379179.29 753926.07  29.79   379179.30 753926.05
27.64   379342.04 754009.81  20.67   379333.25 754005.29  20.65     0.00   0.00   0.00   366.509
0.445
               3                          379179.43 753925.80  25.29   379179.45 753925.78
23.14   379342.18 754009.54  16.17   379333.39 754005.01  16.15     0.00   0.00   0.00   366.509
0.445

      8   1     1 tdl_zeb_132.035       GW 379501.14 754100.66  37.88   379501.14 754100.66
37.88   379652.86 754178.74  28.56   379669.19 754187.14  28.47     0.00   0.00   0.00   341.747
0.459
               2                          379504.75 754093.64  37.88   379504.75 754093.64
37.88   379656.48 754171.71  28.56   379672.80 754180.12  28.47     0.00   0.00   0.00   341.747
0.459
         2     1                       P1 379501.14 754100.66  35.93   379501.14 754100.66
33.78   379652.86 754178.74  25.34   379671.28 754188.22  25.24     0.00   0.00   0.00   341.648
0.360
               2                          379501.10 754100.72  31.48   379501.10 754100.72
29.33   379652.83 754178.80  20.89   379671.25 754188.28  20.79     0.00   0.00   0.00   341.648
0.360
               3                          379500.96 754101.00  26.98   379500.96 754101.00
24.83   379652.69 754179.08  16.39   379671.11 754188.56  16.29     0.00   0.00   0.00   341.648
0.360
         3     1                          379504.75 754093.64  35.93   379504.75 754093.64
33.78   379656.48 754171.71  25.34   379674.89 754181.19  25.24     0.00   0.00   0.00   341.648
0.360
               2                          379504.78 754093.57  31.48   379504.78 754093.57
29.33   379656.51 754171.65  20.89   379674.93 754181.13  20.79     0.00   0.00   0.00   341.648
0.360
               3                          379504.92 754093.30  26.98   379504.92 754093.30
24.83   379656.65 754171.38  16.39   379675.07 754180.86  16.29     0.00   0.00   0.00   341.648
0.360

      9   1     1 tdl_zeb_132.032       GW 379804.59 754256.82  34.58   379804.59 754256.82
34.58   379964.26 754338.99  27.86   379947.57 754330.40  27.77     0.00   0.00   0.00   359.706
0.535
               2                          379808.20 754249.79  34.58   379808.20 754249.79
34.58   379967.87 754331.96  27.86   379951.18 754323.37  27.77     0.00   0.00   0.00   359.706
0.535
         2     1                       P1 379804.59 754256.82  32.63   379804.59 754256.82
30.48   379964.26 754338.99  24.73   379945.40 754329.28  24.63     0.00   0.00   0.00   359.591
0.420
               2                          379804.55 754256.88  28.18   379804.55 754256.88
26.03   379964.23 754339.05  20.28   379945.37 754329.35  20.18     0.00   0.00   0.00   359.591
0.420
               3                          379804.41 754257.16  23.68   379804.41 754257.16
21.53   379964.09 754339.33  15.78   379945.23 754329.62  15.68     0.00   0.00   0.00   359.591
0.420
         3     1                          379808.20 754249.79  32.63   379808.20 754249.79
30.48   379967.87 754331.96  24.73   379949.02 754322.26  24.63     0.00   0.00   0.00   359.591
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0.420
                2                              379808.23 754249.73  28.18   379808.23 754249.73
26.03   379967.91 754331.90  20.28   379949.05 754322.20  20.18     0.00   0.00   0.00   359.591
0.420
                3                              379808.37 754249.46  23.68   379808.37 754249.46
21.53   379968.05 754331.63  15.78   379949.19 754321.92  15.68     0.00   0.00   0.00   359.591
0.420

     10   1     1 tdl_zeb_132.035      GW 380123.93 754421.16  38.13   380123.93 754421.16
38.13   380298.54 754511.01  27.47   380302.88 754513.24  27.47     0.00   0.00   0.00   393.434
0.699
                2                              380127.55 754414.13  38.13   380127.55 754414.13
38.13   380302.15 754503.99  27.47   380306.49 754506.22  27.47     0.00   0.00   0.00   393.434
0.699
          2     1                        P1 380123.93 754421.16  36.18   380123.93 754421.16
34.03   380298.54 754511.01  24.53   380303.45 754513.54  24.52     0.00   0.00   0.00   393.284
0.549
                2                              380123.90 754421.22  31.73   380123.90 754421.22
29.58   380298.51 754511.07  20.08   380303.42 754513.60  20.07     0.00   0.00   0.00   393.284
0.549
                3                              380123.76 754421.50  27.23   380123.76 754421.50
25.08   380298.36 754511.35  15.58   380303.28 754513.88  15.57     0.00   0.00   0.00   393.284
0.549
          3     1                              380127.55 754414.13  36.18   380127.55 754414.13
34.03   380302.15 754503.99  24.53   380307.07 754506.52  24.52     0.00   0.00   0.00   393.284
0.549
                2                              380127.58 754414.07  31.73   380127.58 754414.07
29.58   380302.18 754503.93  20.08   380307.10 754506.45  20.07     0.00   0.00   0.00   393.284
0.549
                3                              380127.72 754413.80  27.23   380127.72 754413.80
25.08   380302.33 754503.65  15.58   380307.24 754506.18  15.57     6.08   0.00   0.00   393.284
0.549

     11   1     1 tdl_zeb_132.035      GW 380473.14 754600.86  37.12   380473.14 754600.86
37.12   380630.90 754682.05  27.21   380646.34 754689.99  27.13     0.00   0.00   0.00   355.383
0.516
                2                              380476.76 754593.84  37.12   380476.76 754593.84
37.12   380634.52 754675.03  27.21   380649.95 754682.97  27.13     0.00   0.00   0.00   355.383
0.516
          2     1                        P1 380473.14 754600.86  35.17   380473.14 754600.86
33.02   380630.90 754682.05  24.05   380648.34 754691.02  23.96     0.00   0.00   0.00   355.272
0.405
                2                              380473.11 754600.93  30.72   380473.11 754600.93
28.57   380630.87 754682.11  19.60   380648.31 754691.09  19.51     0.00   0.00   0.00   355.272
0.405
                3                              380472.97 754601.20  26.22   380472.97 754601.20
24.07   380630.73 754682.39  15.10   380648.17 754691.36  15.01     0.00   0.00   0.00   355.272
0.405
          3     1                              380476.76 754593.84  35.17   380476.76 754593.84
33.02   380634.52 754675.03  24.05   380651.96 754684.00  23.96     0.00   0.00   0.00   355.272
0.405
                2                              380476.79 754593.78  30.72   380476.79 754593.78
28.57   380634.55 754674.96  19.60   380651.99 754683.94  19.51     0.00   0.00   0.00   355.272
0.405
                3                              380476.93 754593.50  26.22   380476.93 754593.50
24.07   380634.69 754674.69  15.10   380652.13 754683.66  15.01     0.00   0.00   0.00   355.272
0.405

     12   1     1 tdl_zeb_132.032      GW 380788.67 754763.24  33.87   380788.67 754763.24
33.87   380933.89 754837.97  28.49   380916.86 754829.21  28.40     0.00   0.00   0.00   327.079
0.402
                2                              380792.28 754756.21  33.87   380792.28 754756.21
33.87   380937.51 754830.95  28.49   380920.47 754822.18  28.40     0.00   0.00   0.00   327.079
0.402
          2     1                        P1 380788.67 754763.24  31.92   380788.67 754763.24
29.77   380933.89 754837.97  25.19   380914.69 754828.09  25.09     0.00   0.00   0.00   326.992
0.316
                2                              380788.63 754763.30  27.47   380788.63 754763.30
25.32   380933.86 754838.03  20.74   380914.66 754828.15  20.64     0.00   0.00   0.00   326.992
0.316
                3                              380788.49 754763.57  22.97   380788.49 754763.57
20.82   380933.72 754838.31  16.24   380914.52 754828.43  16.14     0.00   0.00   0.00   326.992
0.316
          3     1                              380792.28 754756.21  31.92   380792.28 754756.21
29.77   380937.51 754830.95  25.19   380918.31 754821.07  25.09     0.00   0.00   0.00   326.992
0.316
                2                              380792.31 754756.15  27.47   380792.31 754756.15
25.32   380937.54 754830.89  20.74   380918.34 754821.01  20.64     0.00   0.00   0.00   326.992
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0.316
               3                          380792.45 754755.87  22.97   380792.45 754755.87
20.82   380937.68 754830.61  16.24   380918.48 754820.73  16.14     0.00   0.00   0.00   326.992
0.316

     13   1     1 tdl_zeb_132.032      GW 381079.12 754912.71  37.16   381079.12 754912.71
37.16   381222.27 754986.37  29.98   381226.09 754988.34  29.97     0.00   0.00   0.00   322.358
0.385
               2                          381082.74 754905.68  37.16   381082.74 754905.68
37.16   381225.88 754979.35  29.98   381229.71 754981.32  29.97     0.00   0.00   0.00   322.358
0.385
          2    1                        P1 381079.12 754912.71  35.21   381079.12 754912.71
33.06   381222.26 754986.38  26.65   381226.58 754988.60  26.65     0.00   0.00   0.00   322.275
0.302
               2                          381079.09 754912.77  30.76   381079.09 754912.77
28.61   381222.23 754986.44  22.20   381226.54 754988.66  22.20     0.00   0.00   0.00   322.275
0.302
               3                          381078.95 754913.05  26.26   381078.95 754913.05
24.11   381222.09 754986.72  17.70   381226.40 754988.94  17.70     0.00   0.00   0.00   322.275
0.302
          3    1                          381082.74 754905.68  35.21   381082.74 754905.68
33.06   381225.88 754979.34  26.65   381230.20 754981.56  26.65     0.00   0.00   0.00   322.275
0.302
               2                          381082.77 754905.62  30.76   381082.77 754905.62
28.61   381225.92 754979.28  22.20   381230.23 754981.50  22.20     0.00   0.00   0.00   322.275
0.302
               3                          381082.91 754905.35  26.26   381082.91 754905.35
24.11   381226.06 754979.00  17.70   381230.38 754981.22  17.70     0.00   0.00   0.00   322.275
0.302

     14   1     1 tdl_zeb_132.035      GW 381365.41 755060.04  36.44   381365.41 755060.04
36.44   381516.07 755137.84  27.31   381531.51 755145.81  27.23     0.00   0.00   0.00   339.600
0.450
               2                          381369.02 755053.01  36.44   381369.02 755053.01
36.44   381520.58 755130.73  27.25   381535.97 755138.62  27.17     0.00   0.00   0.00   341.119
0.456
          2    1                        P1 381365.41 755060.04  34.49   381365.40 755060.05
32.34   381515.12 755137.36  24.14   381532.93 755146.55  24.04     0.00   0.00   0.00   337.353
0.353
               2                          381365.38 755060.10  30.04   381365.37 755060.12
27.89   381515.07 755137.43  19.66   381533.17 755146.78  19.56     0.00   0.00   0.00   337.336
0.353
               3                          381365.24 755060.37  25.54   381365.22 755060.39
23.39   381514.88 755137.73  15.16   381532.97 755147.08  15.07     0.00   0.00   0.00   337.269
0.353
          3    1                          381369.02 755053.01  34.49   381369.03 755052.99
32.34   381519.63 755130.23  24.08   381537.40 755139.35  23.98     0.00   0.00   0.00   338.870
0.358
               2                          381369.06 755052.95  30.04   381369.07 755052.93
27.89   381519.68 755130.16  19.60   381537.72 755139.41  19.50     0.00   0.00   0.00   338.887
0.358
               3                          381369.20 755052.67  25.54   381369.21 755052.65
23.39   381519.87 755129.86  15.10   381537.92 755139.11  15.00     0.00   0.00   0.00   338.955
0.359

     15   1     1 td3_zeb_132.028      GW 381666.74 755215.65  33.33   381666.74 755215.65
33.33   381778.09 755332.97  26.96   381773.89 755328.55  26.95     5.22   0.00   0.00   323.911
0.391
               2                          381672.14 755208.45  33.33   381672.14 755208.45
33.33   381783.67 755326.66  26.90   381779.51 755322.26  26.89     0.00   0.00   0.00   325.429
0.396
          2    1                        C1 381666.74 755215.65  29.33   381668.21 755217.20
29.18   381778.82 755333.76  23.70   381773.81 755328.48  23.69     5.22   0.00   0.00   321.677
0.307
               2                          381666.68 755215.73  24.83   381668.15 755217.28
24.68   381778.77 755333.82  19.22   381773.54 755328.32  19.21     5.21   0.00   0.00   321.660
0.307
               3                          381666.44 755216.05  20.33   381667.91 755217.60
20.18   381778.53 755334.09  14.73   381773.28 755328.56  14.71     5.17   0.00   0.00   321.593
0.307
          3    1                        C2 381672.14 755208.45  29.33   381673.61 755210.01
29.18   381784.41 755327.43  23.64   381779.45 755322.17  23.63     0.00   0.00   0.00   323.193
0.311
               2                          381672.20 755208.37  24.83   381673.67 755209.93
24.68   381784.46 755327.37  19.17   381779.26 755321.85  19.15     0.00   0.00   0.00   323.211
0.311
               3                          381672.44 755208.05  20.33   381673.91 755209.61
20.18   381784.70 755327.10  14.66   381779.49 755321.58  14.65     0.00   0.00   0.00   323.278
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0.311

     16   1     1 tdl_zeb_132.032      GW 381889.45 755450.30  34.37   381889.45 755450.30
34.37   382000.33 755567.47  28.34   381993.66 755560.42  28.31     0.00   0.00   0.00   323.026
0.388
               2                          381895.19 755444.87  34.37   381895.19 755444.87
34.37   382006.07 755562.04  28.34   381999.39 755554.99  28.31     0.00   0.00   0.00   323.026
0.388
          2    1                        P1 381889.45 755450.30  32.42   381889.44 755450.32
30.27   382000.32 755567.48  25.02   381992.81 755559.54  24.99     0.00   0.00   0.00   322.943
0.304
               2                          381889.40 755450.35  27.97   381889.38 755450.37
25.82   382000.27 755567.53  20.57   381992.76 755559.59  20.54     0.00   0.00   0.00   322.943
0.304
               3                          381889.18 755450.56  23.47   381889.16 755450.58
21.32   382000.04 755567.74  16.07   381992.53 755559.81  16.04     0.00   0.00   0.00   322.943
0.304
          3    1                          381895.19 755444.87  32.42   381895.21 755444.86
30.27   382006.07 755562.04  25.02   381998.56 755554.10  24.99     0.00   0.00   0.00   322.943
0.304
               2                          381895.24 755444.82  27.97   381895.26 755444.81
25.82   382006.13 755561.99  20.57   381998.61 755554.05  20.54     0.00   0.00   0.00   322.943
0.304
               3                          381895.47 755444.61  23.47   381895.48 755444.59
21.32   382006.35 755561.77  16.07   381998.84 755553.83  16.04     0.00   0.00   0.00   322.943
0.304

     17   1     1 tdl_zeb_132.032      GW 382111.21 755684.65  36.01   382111.21 755684.65
36.01   382228.03 755808.11  29.27   382221.37 755801.06  29.25     0.00   0.00   0.00   340.409
0.453
               2                          382116.94 755679.22  36.01   382116.94 755679.22
36.01   382233.77 755802.68  29.27   382227.10 755795.63  29.25     0.00   0.00   0.00   340.409
0.453
          2    1                        P1 382111.21 755684.65  34.06   382111.21 755684.65
31.91   382228.03 755808.11  26.04   382220.51 755800.16  26.01     0.00   0.00   0.00   340.311
0.356
               2                          382111.15 755684.69  29.61   382111.15 755684.69
27.46   382227.98 755808.16  21.59   382220.46 755800.21  21.56     0.00   0.00   0.00   340.311
0.356
               3                          382110.93 755684.91  25.11   382110.93 755684.91
22.96   382227.76 755808.37  17.09   382220.28 755800.42  17.06     0.00   0.00   0.00   340.311
0.356
          3    1                          382116.94 755679.22  34.06   382116.94 755679.22
31.91   382233.77 755802.68  26.04   382226.25 755794.73  26.01     0.00   0.00   0.00   340.311
0.356
               2                          382116.99 755679.17  29.61   382116.99 755679.17
27.46   382233.82 755802.63  21.59   382226.30 755794.68  21.56     0.00   0.00   0.00   340.311
0.356
               3                          382117.22 755678.96  25.11   382117.22 755678.96
22.96   382234.05 755802.42  17.09   382226.53 755794.47  17.06     0.00   0.00   0.00   340.311
0.356

     18   1     1 tdl_zeb_132.032      GW 382344.86 755931.57  37.75   382344.86 755931.57
37.75   382467.25 756060.91  31.81   382449.60 756042.26  31.63     0.00   0.00   0.00   356.694
0.521
               2                          382350.60 755926.14  37.75   382350.60 755926.14
37.75   382472.99 756055.48  31.81   382455.34 756036.83  31.63     0.00   0.00   0.00   356.694
0.521
          2    1                        P1 382344.86 755931.57  35.80   382344.86 755931.57
33.65   382467.25 756060.92  28.66   382447.33 756039.86  28.46     0.00   0.00   0.00   356.582
0.409
               2                          382344.81 755931.62  31.35   382344.81 755931.62
29.20   382467.20 756060.97  24.21   382447.27 756039.91  24.01     0.00   0.00   0.00   356.582
0.409
               3                          382344.59 755931.83  26.85   382344.59 755931.83
24.70   382466.97 756061.18  19.71   382447.05 756040.12  19.51     0.00   0.00   0.00   356.582
0.409
          3    1                          382350.60 755926.14  35.80   382350.60 755926.14
33.65   382473.00 756055.48  28.66   382453.07 756034.42  28.46     0.00   0.00   0.00   356.582
0.409
               2                          382350.65 755926.09  31.35   382350.65 755926.09
29.20   382473.05 756055.43  24.21   382453.13 756034.37  24.01     0.00   0.00   0.00   356.582
0.409
               3                          382350.88 755925.88  26.85   382350.88 755925.88
24.70   382473.28 756055.21  19.71   382453.35 756034.16  19.51     0.00   0.00   0.00   356.582
0.409

     19   1     1 tdl_zeb_132.035      GW 382589.65 756190.25  42.57   382589.65 756190.25
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42.57   382697.04 756304.05  34.77   382708.30 756315.98  34.70     0.00   0.00   0.00   313.305
0.354
              2                          382595.38 756184.82  42.57   382595.38 756184.82
42.57   382703.81 756299.10  34.68   382715.02 756310.91  34.61     0.00   0.00   0.00   315.423
0.361
         2    1                        P1 382589.65 756190.25  40.62   382589.63 756190.26
38.47   382696.29 756303.28  31.46   382709.28 756317.03  31.38     0.00   0.00   0.00   311.078
0.278
              2                          382589.59 756190.30  36.17   382589.58 756190.31
34.02   382696.23 756303.33  26.99   382709.44 756317.33  26.90     0.00   0.00   0.00   311.055
0.278
              3                          382589.37 756190.51  31.67   382589.35 756190.53
29.52   382695.94 756303.53  22.49   382709.14 756317.53  22.40     0.00   0.00   0.00   310.961
0.277
         3    1                          382595.38 756184.82  40.62   382595.40 756184.81
38.47   382703.08 756298.31  31.38   382716.00 756311.93  31.30     0.00   0.00   0.00   313.195
0.283
              2                          382595.43 756184.77  36.17   382595.45 756184.76
34.02   382703.15 756298.26  26.91   382716.31 756312.13  26.82     0.00   0.00   0.00   313.219
0.283
              3                          382595.66 756184.56  31.67   382595.67 756184.55
29.52   382703.43 756298.06  22.41   382716.60 756311.93  22.32     0.00   0.00   0.00   313.313
0.284

     20   1    1 td3_zeb_132.028      GW 382804.43 756417.85  39.86   382804.43 756417.85
39.86   382838.69 756535.10  38.43   382827.79 756497.82  38.04    12.02   0.00   0.00   244.530
0.168
              2                          382812.23 756413.37  39.86   382812.23 756413.37
39.86   382845.90 756528.48  38.57   382834.79 756490.50  38.16     0.00   0.00   0.00   240.075
0.159
         2    1                        C1 382804.43 756417.85  35.86   382805.03 756419.91
35.77   382838.74 756535.03  34.01   382830.73 756507.67  33.82    12.02   0.00   0.00   240.051
0.132
              2                          382804.34 756417.90  31.36   382804.94 756419.96
31.27   382838.49 756535.33  29.45   382830.79 756508.84  29.27    12.03   0.00   0.00   240.445
0.133
              3                          382803.99 756418.10  26.86   382804.59 756420.16
26.77   382838.08 756535.75  24.86   382830.77 756510.54  24.70    12.06   0.00   0.00   240.828
0.133
         3    1                        C2 382812.23 756413.37  35.86   382812.84 756415.43
35.77   382845.84 756528.56  34.13   382837.71 756500.70  33.93     0.00   0.00   0.00   235.825
0.125
              2                          382812.32 756413.32  31.36   382812.93 756415.38
31.27   382846.09 756528.25  29.59   382838.15 756501.23  29.40     0.00   0.00   0.00   235.428
0.125
              3                          382812.67 756413.12  26.86   382813.28 756415.18
26.77   382846.51 756527.83  25.02   382838.90 756502.05  24.86     0.00   0.00   0.00   235.042
0.124

     21   1    1 tdt_zeb_132.030      GW 382872.94 756652.35  44.86   382872.94 756652.35
44.86        0.00      0.00   0.00        0.00      0.00   0.00     0.00   0.00   0.00     0.000
0.000
              2                          382879.56 756643.59  44.86   382879.56 756643.59
44.86        0.00      0.00   0.00        0.00      0.00   0.00    14.63   0.00   0.00     0.000
0.000
         2    1                        C1 382873.06 756652.20  39.11   382872.46 756650.14
38.96        0.00      0.00   0.00        0.00      0.00   0.00     0.00   0.00   0.00     0.000
0.000
              2                          382872.64 756652.76  34.51   382872.04 756650.70
34.36        0.00      0.00   0.00        0.00      0.00   0.00     0.00   0.00   0.00     0.000
0.000
              3                          382872.16 756653.40  29.86   382871.56 756651.34
29.71        0.00      0.00   0.00        0.00      0.00   0.00     0.00   0.00   0.00     0.000
0.000
         3    1                        C2 382879.44 756643.74  39.11   382878.84 756641.68
38.96        0.00      0.00   0.00        0.00      0.00   0.00    14.64   0.00   0.00     0.000
0.000
              2                          382879.87 756643.18  34.51   382879.26 756641.12
34.36        0.00      0.00   0.00        0.00      0.00   0.00    14.61   0.00   0.00     0.000
0.000
              3                          382880.35 756642.54  29.86   382879.74 756640.49
29.71        0.00      0.00   0.00        0.00      0.00   0.00    14.58   0.00   0.00     0.000
0.000
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Section Sagging Data

Sec. No.	Cable File Name	From Str.	To Str.	Voltage (kV)	Ruling Span (m)	Sagging Data Condition	Temp. (deg C)	Catenary Constant (m)	Horiz. Tension (N)	Weather Case	Catenary Constant (m)
1	steelwire_7_335	1	21	0	345.6	Creep RS	32.0	2000.0	9740.0	Hot	1684.3
2	lynx_acsr.wir	1	21	132	345.1	Creep RS	32.0	2230.0	18485.2	Hot	1756.9
3	lynx_acsr.wir	1	21	132	346.1	Creep RS	32.0	2230.0	18485.2	Hot	1758.2

Section Stringing Data

Section Number	Cable Name	Struct. Number	Set Number	Phasing	Set Label
1	steelwire_7_335	1	1	12	GW
		2	1	12	GW
		3	1	12	GW
		4	1	12	GW
		5	1	12	GW
		6	1	12	GW
		7	1	12	GW
		8	1	12	GW
		9	1	12	GW
		10	1	12	GW
		11	1	12	GW
		12	1	12	GW
		13	1	12	GW
		14	1	12	GW
		15	1	12	GW
		16	1	12	GW
		17	1	12	GW
		18	1	12	GW
		19	1	12	GW
		20	1	12	GW
		21	1	12	GW
2	lynx_acsr.wir	1	2	123	C1
		2	2	123	C1
		3	2	123	C1
		4	2	123	P1
		5	2	123	P1
		6	2	123	C1
		7	2	123	P1
		8	2	123	P1
		9	2	123	P1
		10	2	123	P1
		11	2	123	P1
		12	2	123	P1
		13	2	123	P1
		14	2	123	P1
		15	2	123	C1
		16	2	123	P1
		17	2	123	P1
		18	2	123	P1
		19	2	123	P1
		20	2	123	C1
		21	2	123	C1
3	lynx_acsr.wir	1	3	123	C2
		2	3	123	C2
		3	3	123	C2
		4	3	123	P1
		5	3	123	P1
		6	3	123	C2
		7	3	123	P1
		8	3	123	P1
		9	3	123	P1
		10	3	123	P1
		11	3	123	P1
		12	3	123	P1

13	3	123 P1
14	3	123 P1
15	3	123 C2
16	3	123 P1
17	3	123 P1
18	3	123 P1
19	3	123 P1
20	3	123 C2
21	3	123 C2

Section Geometry Data

Notes: Lengths are arc lengths along the wire at 32 (deg C), Creep.
Lengths are adjusted for the number of phases, the number of subconductors and to exclude the length of strain insulators.
Lengths are computed with any concentrated loads removed.

Sec. No.	Cable File Name	From Str.	To Str.	Number of Phases	Wires Per Phase	Min. Span (m)	Max. Span (m)	Ruling Span (m)	Total Cable Length (m)
1	steelwire_7_335	1	21	2	1	242.1	407.0	345.6	13606.9
2	lynx_acsr.wir	1	21	3	1	244.6	402.6	345.1	20304.3
3	lynx_acsr.wir	1	21	3	1	239.6	411.3	346.1	20351.5

Structure Material List Report

Structure Number in Selected

File Name Number in All

Line Lines

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f:\msc\pls cadd simulations\pannipitiya- panadura transmission line\panni_rath_lynx\tdt_zeb.0350 0
f:\msc\pls cadd simulations\pannipitiya- panadura transmission line\structures\td3_zeb_132.0320 0
f:\msc\pls cadd simulations\pannipitiya- panadura transmission line\structures\td3_zeb_132.0351 1
f:\msc\pls cadd simulations\pannipitiya- panadura transmission line\structures\td6_zeb_132.0320 0

f:\msc\pls cadd simulations\pannipitiya- panadura transmission line\structures\td6_zeb_132.035
1 1
f:\msc\pls cadd simulations\pannipitiya- panadura transmission line\structures\td6_zeb_132.038
0 0
f:\msc\pls cadd simulations\pannipitiya- panadura transmission line\structures\tdt_zeb_132.030
1 1
Total number of structures =
21 21

Cable Material List Report

Notes: Lengths are arc lengths along the wire at 32 (deg C), Creep.
Lengths are adjusted for the number of phases, the number of subconductors and to exclude the length of strain insulators.
Lengths are computed with any concentrated loads removed.

Cable Number File Of Sections	Cable Name	Length At Stringing Condition (m)	
f:\msc\pls cadd simulations\pannipitiya- panadura transmission line\panni_rath_lynx\cables\steelwire_7_335	1	13607	
f:\msc\pls cadd simulations\pannipitiya- panadura transmission line\panni_rath_lynx\lynx_acsr	2	40656	

PLS-CADD Version 13.20x64 2:30:52 PM Friday, March 27, 2015
Ceylon Electricity Board - Transmission Design
Project Name: 'f:\msc\pls cadd simulations\pannipitiya- panadura transmission line \panni_rath_lynx\pannipitiya ratmalana line.DON'

EMF Calculation Notes:
  1) All calculations based on the EPRI Red Book methods (2nd Edition, 1982 - infinite straight wire with flat earth approximation).
  2) These approximations are only valid for low frequency (50-60Hz) AC transmission lines.
  3) Bundles are modeled with an equivalent conductor as per EPRI Red Book 8.3.1.
  4) The effects of earth return currents (earth resistivity) are ignored when calculating the magnetic field.
  5) Wire position is determined by the currently displayed weather case.
  6) Wire height used is the height of the wire where the target point is projected upon it.
  7) All calculations assume ground is flat with same elevation as that of centerline.

Meter height above centerline ground: 1.00 (m)
Cross section offset for graph +/-: 27.00 (m)
Result interval for graph: 1.00 (m)
Electric field limit: 5.00 (kV/m)
Magnetic field limit: 100.00 (uT)

EMF calculation includes only wires going from structure 4 to structure 5

EMF Circuit Data:

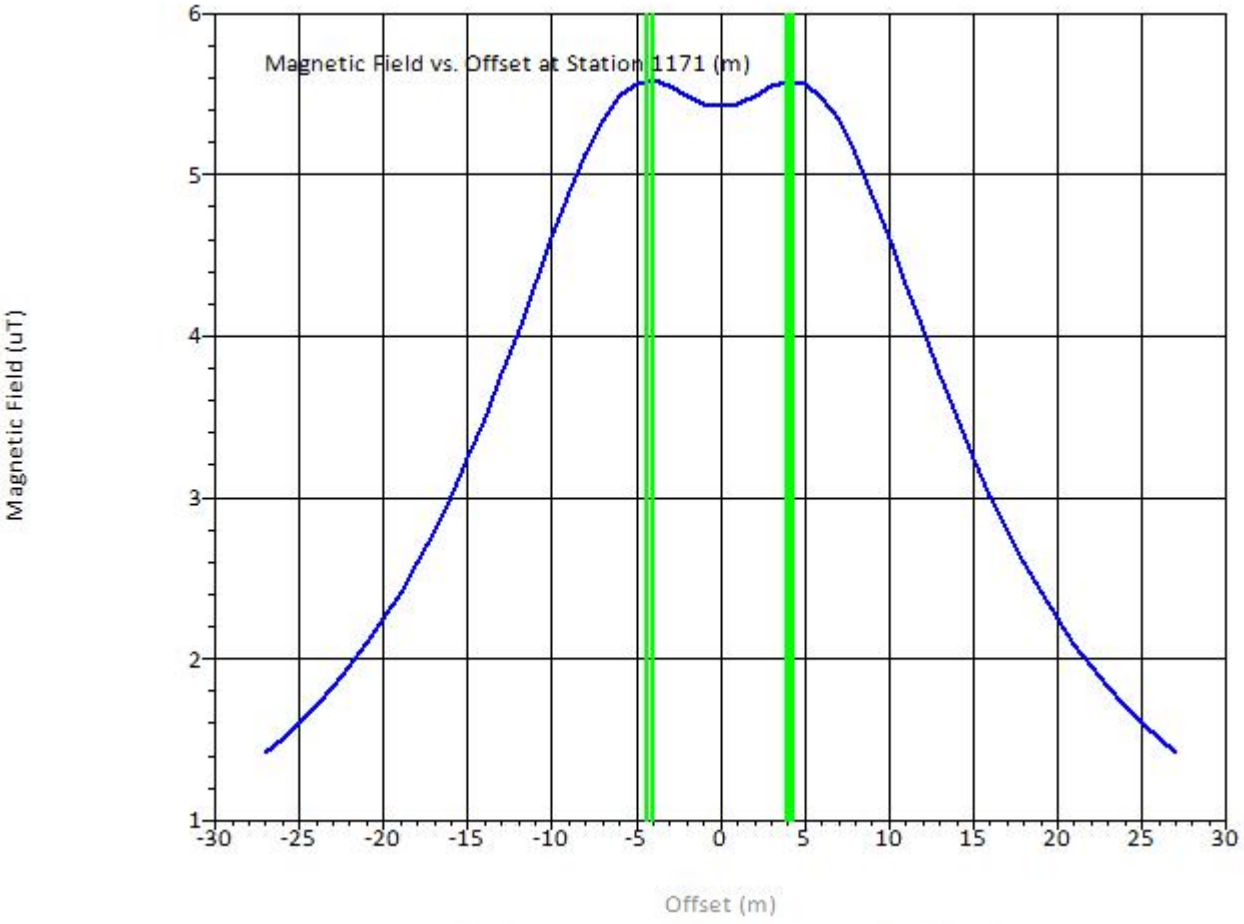
Set #	Phase #	Conductors Per Phase	Voltage Ph-Ph (kV)	Current (Amps)	Phase Angle (deg)	Bundle Diameter (cm)
1	1	1	0	0.000	0	0.000
1	2	1	0	0.000	0	0.000
2	1	1	132	400.000	0	0.000
2	2	1	132	400.000	120	0.000
2	3	1	132	400.000	-120	0.000
3	1	1	132	400.000	0	0.000
3	2	1	132	400.000	120	0.000
3	3	1	132	400.000	-120	0.000

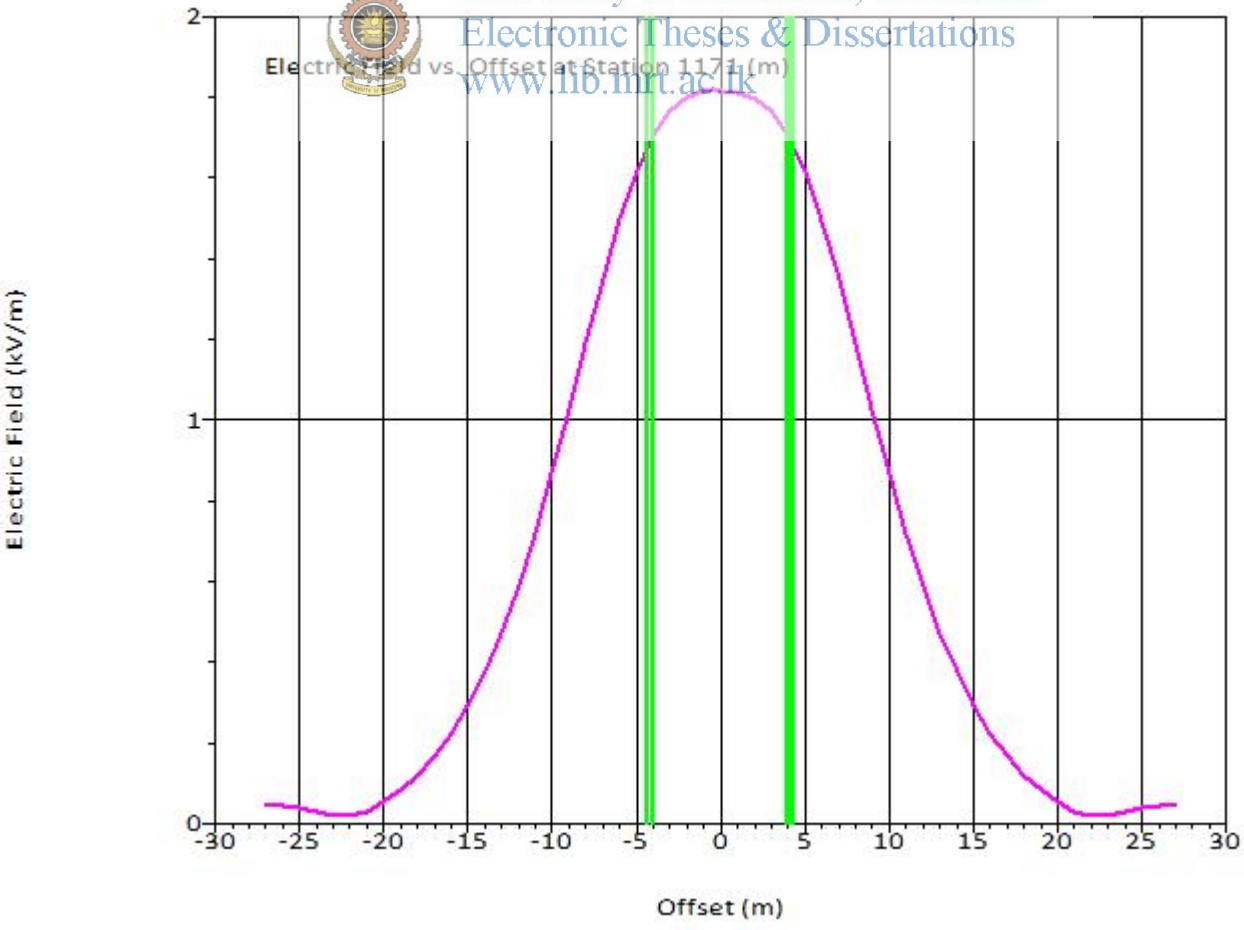
Calculated EMF Circuit Data For Last Point:

Wire station and offset are based on alignment closest to point on wire.
In the case of wires that are not parallel, this may result in different stations for the wires and centerline.

Set #	Phase #	Weather Case	Cable Condition	Wind From	Wire X (m)	Wire Y (m)	Wire Z (m)	Station (m)	Offset (m)	Eqv. Wire Diameter (cm)	Voltage To Gnd. (kV)
1	1	Hot	Creep RS	Left	378425.26	753405.45	26.65	1171.15	-3.95	1.023	0
1	2	Hot	Creep RS	Left	378430.34	753399.40	26.65	1171.15	3.95	1.023	0
2	1	Hot	Creep RS	Left	378425.25	753405.46	22.94	1171.15	-3.96	1.956	76.21
2	2	Hot	Creep RS	Left	378425.21	753405.51	18.49	1171.15	-4.04	1.956	76.21
2	3	Hot	Creep RS	Left	378425.00	753405.75	13.99	1171.15	-4.35	1.956	76.21
3	1	Hot	Creep RS	Left	378430.35	753399.39	22.94	1171.15	3.96	1.956	76.21
3	2	Hot	Creep RS	Left	378430.40	753399.34	18.49	1171.15	4.04	1.956	76.21
3	3	Hot	Creep RS	Left	378430.60	753399.10	13.99	1171.15	4.35	1.956	76.21

Maximum magnetic field of 5.58 (uT) found at station 1171.15, offset -4.00 (m)
Maximum electric field of 1.816 (kV/m) found at station 1171.15, offset -0.00 (m)





EMF Calculation Results:

Station	Offset	X	Y	Z	B Real	B Img.	B Phase Angle	B rms Res.	E Real	E Img.	E Phase Angle	E rms Res.
	(m)	(m)	(m)	(m)	(uT)	(uT)	(deg)	(uT)	(kV/m)	(kV/m)	(deg)	(kV/m)
1171.15	-27.00	378410.43	753423.09	4.53	1.191	0.76529	32.7	1.416	0.045	0.02449	28.5	95.8 0.051
1171.15	-26.00	378411.07	753422.33	4.53	1.265	0.81768	32.9	1.506	0.040	0.02214	29.0	98.5 0.046
1171.15	-25.00	378411.72	753421.56	4.53	1.345	0.87520	33.1	1.604	0.034	0.01898	29.4	103.1 0.039
1171.15	-24.00	378412.36	753420.80	4.53	1.431	0.93848	33.3	1.711	0.026	0.01499	30.0	111.8 0.030
1171.15	-23.00	378413.00	753420.03	4.53	1.525	1.00819	33.5	1.828	0.018	0.01064	30.5	132.4 0.021
1171.15	-22.00	378413.65	753419.27	4.53	1.628	1.08511	33.7	1.956	0.015	0.00919	31.2	180.5 0.018
1171.15	-21.00	378414.29	753418.50	4.53	1.739	1.17007	33.9	2.096	0.025	0.01569	31.9	221.7 0.030
1171.15	-20.00	378414.93	753417.73	4.53	1.859	1.26398	34.2	2.248	0.044	0.02805	32.6	238.1 0.052
1171.15	-19.00	378415.58	753416.97	4.53	1.991	1.36778	34.5	2.415	0.068	0.04502	33.4	245.4 0.082
1171.15	-18.00	378416.22	753416.20	4.53	2.133	1.48248	34.8	2.597	0.099	0.06708	34.2	249.5 0.119
1171.15	-17.00	378416.86	753415.44	4.53	2.286	1.60899	35.1	2.796	0.136	0.09524	35.1	252.0 0.166
1171.15	-16.00	378417.51	753414.67	4.53	2.452	1.74813	35.5	3.011	0.180	0.13079	36.0	253.8 0.223
1171.15	-15.00	378418.15	753413.91	4.53	2.630	1.90042	35.9	3.244	0.233	0.17525	37.0	255.1 0.291
1171.15	-14.00	378418.79	753413.14	4.53	2.819	2.06588	36.2	3.495	0.295	0.23022	38.0	256.1 0.374
1171.15	-13.00	378419.44	753412.38	4.53	3.018	2.24368	36.6	3.761	0.367	0.29730	39.0	257.1 0.472
1171.15	-12.00	378420.08	753411.61	4.53	3.226	2.43175	37.0	4.040	0.450	0.37772	40.0	258.0 0.587
1171.15	-11.00	378420.72	753410.85	4.53	3.438	2.62623	37.4	4.326	0.543	0.47196	41.0	258.9 0.719
1171.15	-10.00	378421.37	753410.08	4.53	3.649	2.82091	37.7	4.612	0.645	0.57915	41.9	259.9 0.866
1171.15	-9.00	378422.01	753409.31	4.53	3.852	3.00686	38.0	4.886	0.753	0.69646	42.8	260.9 1.026
1171.15	-8.00	378422.65	753408.55	4.53	4.036	3.17254	38.2	5.134	0.864	0.81856	43.5	262.1 1.190
1171.15	-7.00	378423.30	753407.78	4.53	4.192	3.30492	38.2	5.338	0.971	0.93773	44.0	263.5 1.350
1171.15	-6.00	378423.94	753407.02	4.53	4.311	3.39199	38.2	5.486	1.070	1.04486	44.3	264.8 1.495
1171.15	-5.00	378424.58	753406.25	4.53	4.387	3.42661	38.0	5.566	1.154	1.13161	44.4	266.2 1.616
1171.15	-4.00	378425.23	753405.49	4.53	4.420	3.41053	37.7	5.583	1.220	1.19303	44.4	267.4 1.706
1171.15	-3.00	378425.87	753404.72	4.53	4.419	3.35675	37.2	5.549	1.266	1.22941	44.2	268.5 1.765
1171.15	-2.00	378426.52	753403.96	4.53	4.400	3.28817	36.8	5.493	1.296	1.24617	43.9	269.2 1.798
1171.15	-1.00	378427.16	753403.19	4.53	4.380	3.23181	36.4	5.443	1.311	1.25137	43.7	269.7 1.812
1171.15	-0.00	378427.80	753402.42	4.53	4.371	3.20979	36.3	5.423	1.316	1.25207	43.6	270.0 1.816
1171.15	1.00	378428.45	753401.66	4.53	4.379	3.23074	36.4	5.442	1.311	1.25102	43.7	270.3 1.812
1171.15	2.00	378429.09	753400.89	4.53	4.399	3.28615	36.8	5.491	1.295	1.24551	43.9	270.8 1.797
1171.15	3.00	378429.73	753400.13	4.53	4.417	3.35396	37.2	5.546	1.266	1.22851	44.1	271.5 1.764
1171.15	4.00	378430.38	753399.36	4.53	4.417	3.40721	37.6	5.578	1.219	1.19199	44.4	272.6 1.705
1171.15	5.00	378431.02	753398.60	4.53	4.384	3.42302	38.0	5.562	1.153	1.13054	44.4	273.8 1.615
1171.15	6.00	378431.66	753397.83	4.53	4.308	3.38837	38.2	5.481	1.069	1.04386	44.3	275.2 1.494

```
 1171.15   7.00 378432.31 753397.07 4.53 4.189 3.30146    38.2 5.334 0.971 0.93688    44.0
276.5 1.349
 1171.15   8.00 378432.95 753396.30 4.53 4.033 3.16938    38.2 5.130 0.863 0.81790    43.5
277.9 1.189
 1171.15   9.00 378433.59 753395.54 4.53 3.849 3.00406    38.0 4.883 0.752 0.69599    42.8
279.1 1.025
 1171.15  10.00 378434.24 753394.77 4.53 3.647 2.81850    37.7 4.609 0.644 0.57885    41.9
280.1 0.866
 1171.15  11.00 378434.88 753394.00 4.53 3.436 2.62418    37.4 4.323 0.543 0.47179    41.0
281.1 0.719
 1171.15  12.00 378435.52 753393.24 4.53 3.224 2.43003    37.0 4.037 0.450 0.37766    40.0
282.0 0.587
 1171.15  13.00 378436.17 753392.47 4.53 3.017 2.24225    36.6 3.759 0.367 0.29732    39.0
282.9 0.472
 1171.15  14.00 378436.81 753391.71 4.53 2.818 2.06469    36.2 3.493 0.295 0.23029    38.0
283.9 0.374
 1171.15  15.00 378437.45 753390.94 4.53 2.629 1.89944    35.9 3.243 0.233 0.17534    37.0
284.9 0.292
 1171.15  16.00 378438.10 753390.18 4.53 2.451 1.74732    35.5 3.010 0.180 0.13090    36.0
286.2 0.223
 1171.15  17.00 378438.74 753389.41 4.53 2.286 1.60832    35.1 2.795 0.136 0.09535    35.1
288.0 0.166
 1171.15  18.00 378439.38 753388.65 4.53 2.132 1.48191    34.8 2.596 0.099 0.06720    34.2
290.5 0.120
 1171.15  19.00 378440.03 753387.88 4.53 1.990 1.36732    34.5 2.414 0.068 0.04513    33.4
294.5 0.082
 1171.15  20.00 378440.67 753387.11 4.53 1.859 1.26358    34.2 2.248 0.044 0.02814    32.6
301.9 0.052
 1171.15  21.00 378441.31 753386.35 4.53 1.738 1.16974    33.9 2.095 0.025 0.01576    31.9
318.1 0.030
 1171.15  22.00 378441.96 753385.58 4.53 1.627 1.08483    33.7 1.956 0.015 0.00920    31.2
359.0 0.018
 1171.15  23.00 378442.60 753384.82 4.53 1.525 1.00796    33.5 1.828 0.018 0.01058    30.5
47.3 0.021
 1171.15  24.00 378443.24 753384.05 4.53 1.431 0.93827    33.3 1.711 0.026 0.01492    29.9
68.1 0.030
 1171.15  25.00 37844[illegible] 753383.29 4.53 1.344 0.87502    33.1 1.604 0.034 0.01892    29.4
76.9 0.038
 1171.15  26.00 37844[illegible] 753382.52 4.53 1.264 0.81753    32.9 1.506 0.040 0.02207    29.0
81.5 0.046
 1171.15  27.00 37844[illegible] 753381.76 4.53 1.191 0.76517    32.7 1.416 0.045 0.02444    28.5
84.2 0.051
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Appendix E – 50% Lightning Impulse Flashover Voltage

No of Units per String	250 mm unit	280 mm unit	320 mm unit
2	240	250	255
3	330	350	375
4	410	445	465
5	495	540	555
6	575	630	645
7	655	725	735
8	735	810	825
9	815	910	920
10	895	990	1010
11	975	1085	1105
12	1050	1165	1200
13	1130	1255	1300
14	1210	1350	1390
15	1290	1445	1480
16	1370	1535	1580
17	1450	1625	1675
18	1525	1715	1775
19	1605	1805	1870
20	1685	1895	1965
21	1765	1985	2060
22	1850	2080	2155
23	1930	2170	2245
24	2010	2265	2340
25	2095	2360	2435
26	2175	2445	2520
27	2260	2540	2615
28	2340	2625	2710
29	2425	2720	2805
30	2510	2810	2895