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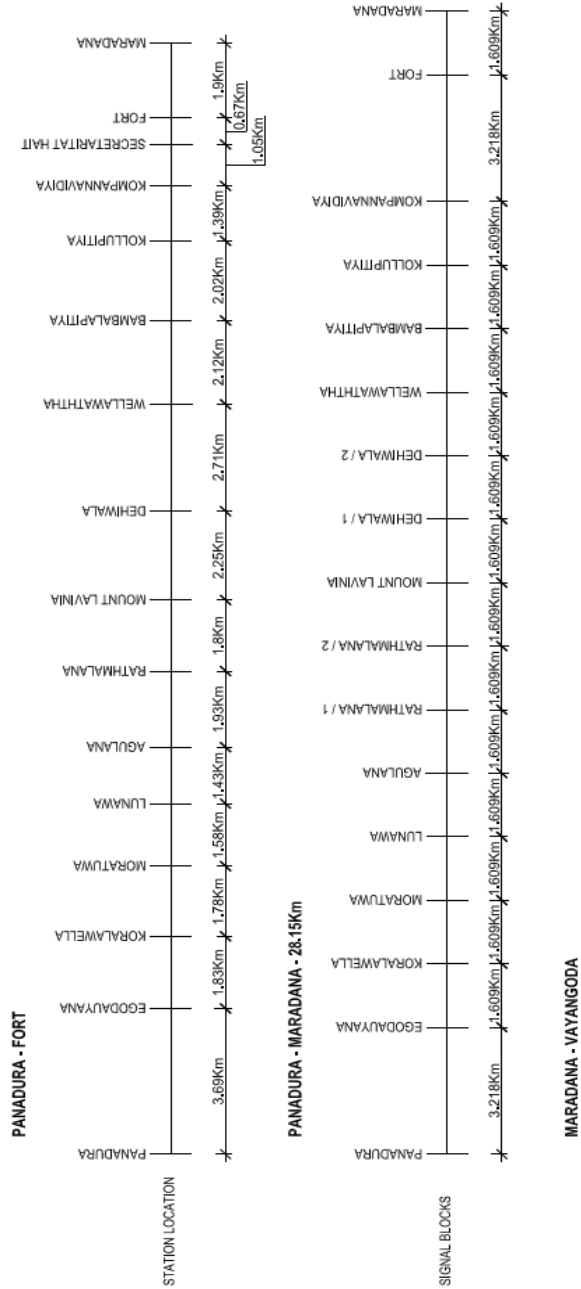
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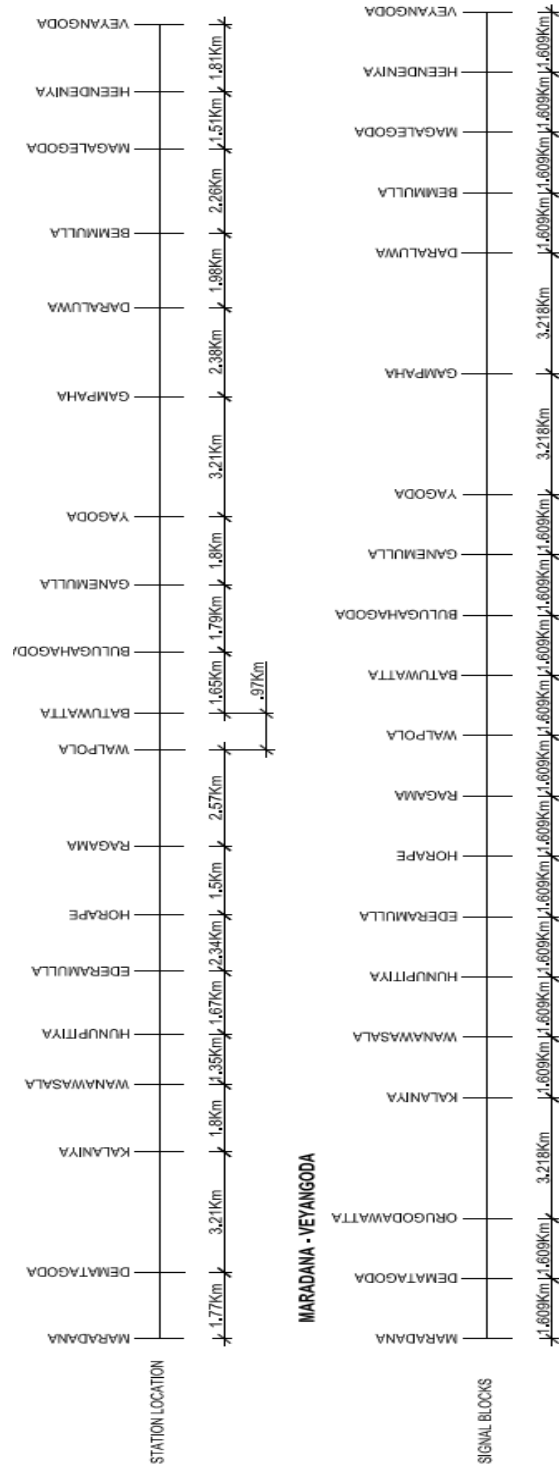
ANNEXURE A - Railway stations located between Panadura to Veyangoda

| No | Distance between two stations | | Distance (km) |
|-----------|--------------------------------------|------------------|----------------------|
| 1 | Panadura | Egodauyana | 3.69 |
| 2 | Egodauyana | Koralawella | 1.83 |
| 3 | Koralawella | Moratuwa | 1.78 |
| 4 | Moratuwa | Lunawa | 1.58 |
| 5 | Lunawa | Angulana | 1.43 |
| 6 | Angulana | Ratmalana | 1.93 |
| 7 | Ratmalana | Mount Lavinia | 1.80 |
| 8 | Mount Lavinia | Dehiwala | 2.25 |
| 9 | Dehiwala | wellawatte | 2.71 |
| 10 | wellawatte | Bambalapitiya | 2.12 |
| 11 | Bambalapitiya | Kollupitiya | 2.02 |
| 12 | Kollupitiya | Kompnnavidiya | 1.39 |
| 13 | Kompnnavidiya | Secretariat Halt | 1.05 |
| 14 | Secretariat Halt | Fort | 0.67 |
| 15 | Fort | Maradana | 1.90 |
| 16 | Maradana | Dematagoda | 1.77 |
| 17 | Dematagoda | Kelaniya | 3.21 |
| 18 | Kelaniya | Wanawasala | 1.80 |
| 19 | Wanawasala | Hunupitiya | 1.35 |
| 20 | Hunupitiya | Enderamulla | 1.67 |
| 21 | Enderamulla | Horape | 2.34 |
| 22 | Horape | Ragama | 1.50 |
| 23 | Ragama | Walpola | 2.57 |
| 24 | Walpola | Batuwatte | 0.97 |
| 25 | Batuwatte | Bulugahagoda | 1.65 |
| 26 | Bulugahagoda | Ganemulla | 1.79 |
| 27 | Ganemulla | Yagoda | 1.80 |
| 28 | Yagoda | Gampaha | 3.21 |
| 29 | Gampaha | Daraluwa | 2.38 |
| 30 | Daraluwa | Bemmulla | 1.98 |
| 31 | Bemmulla | Magelegoda | 2.26 |
| 32 | Magelegoda | Heendeniya | 1.51 |
| 33 | Heendeniya | Veyangoda | 1.81 |
| | Panadura | Veyangoda | 63.727 |

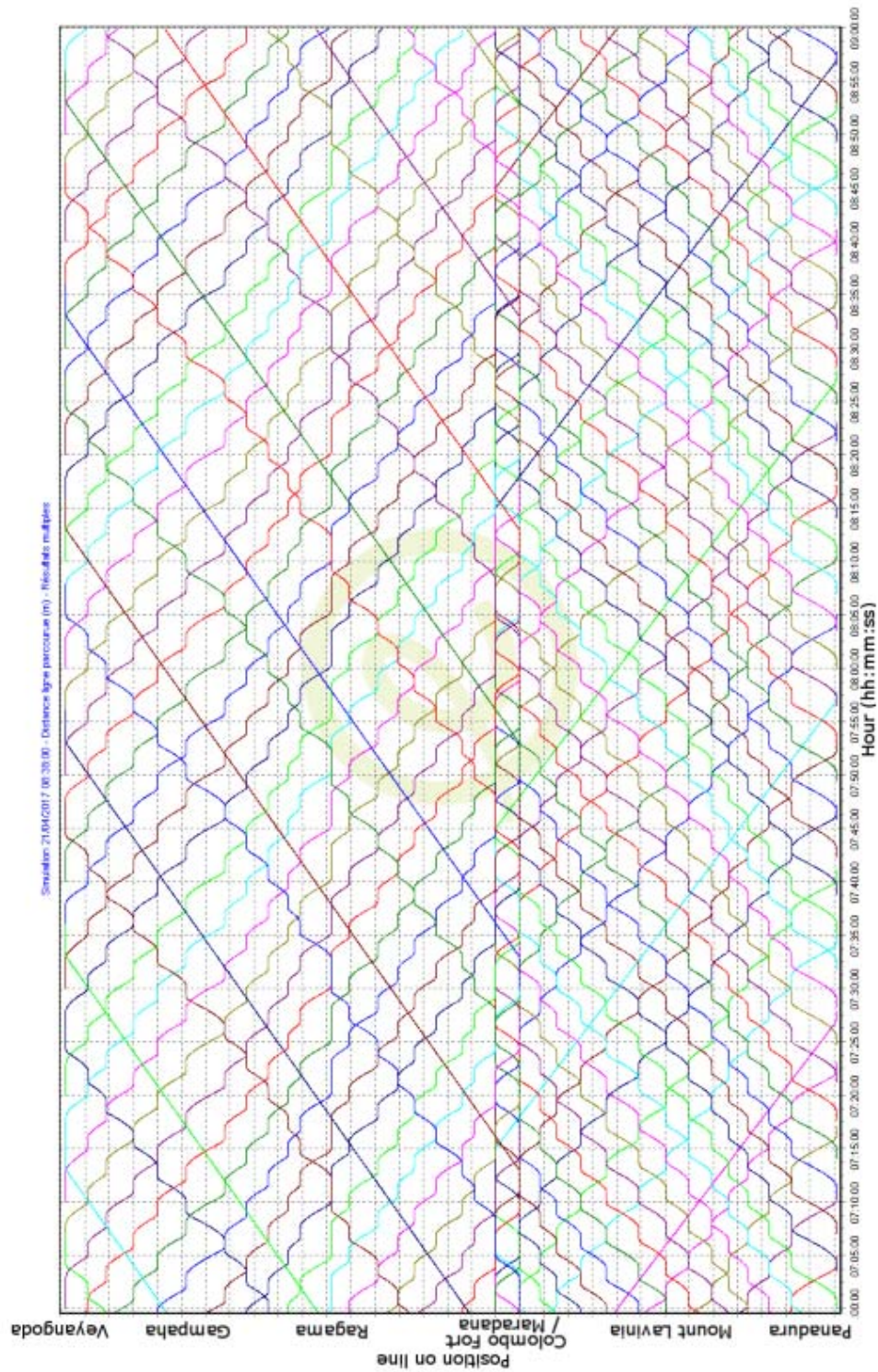
ANNEXURE B - Signal Block System between Panadura and Maradana Railway Stations



ANNEXURE C - Signal Block System between Maradana and Veyangoda Railway Stations



ANNEXURE D - Operation Plan of Train Time Table Simulation forecasted for Year 2035 [30]



ANNEXURE E - MATLAB Code for the Train Model at Staring Station

```

function [u,y1,y2,sta1,p,t0]= fcn(t,a1,a2,Vm,d,gap)
a=0;
temp = 0;
dis1=0;
dis2=0;
n=0;
R=0;
k=0;
f=0;
    n = fix(t/gap); % return the integer valve
if( n*gap<=t && t< 2*n*gap)
    a = n*gap;
end
if(t<(a+Vm/a1) && k>=0)
    k= a1*(t-a);
    dis1=0.5*a1*(t-a)*(t-a);
    f=(210.93*a1*1000+191.75*20)*k/1000000;
    dis2=d-(0.5*a1*(t-a)*(t-a));

elseif(((a+Vm/a1)<=t)&&(t<(a+(Vm/a1+(d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)))&& k>=0)
    k= Vm;
    dis1=0.5*a1*(Vm/a1)*(Vm/a1) + Vm*(t-a-Vm/a1);
    f=(191.75*20)*k/1000000;
    dis2=d-(0.5*a1*(Vm/a1)*(Vm/a1) + Vm*(t-a-Vm/a1));

elseif(((a+(Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))<=t)&&
(t<(a+(Vm/a1+Vm/a2+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm)))&& k>=0)
    k= Vm - (a2*(t-(a+(Vm/a1+(d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)))));
    dis1=0.5*a1*(Vm/a1)*(Vm/a1) + Vm*((d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)+Vm*(t-(a+(Vm/a1+(d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)))-0.5*a2*(((t-(a+(Vm/a1+(d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm))))^2);
    f=(-210.93*a1*1000+191.75*20)*k/1000000;
    dis2=d-(0.5*a1*(Vm/a1)*(Vm/a1)+Vm*((d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)+Vm*(t-(a+(Vm/a1+(d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)))-0.5*a2*(((t-(a+(Vm/a1+(d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm))))^2));
end;
if dis1>=(d-0.0001)
    sta1=1;
else
    sta1=0;
end
% a=a+300;
t0=(Vm/a1+Vm/a2+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm);
p=f;
y1=dis1;
y2=dis2;
u=k;

end

```


ANNEXURE F - MATLAB Code for the Train Model at Intermediate Station

```

function [u,y1,y2,p, st1,t1]= fcn(time,t,a1,a2,Vm,d,gap,t0)
k=0;
dis1=0;
dis2=0;
f=0;
if(time>(t0+gap))
% n = fix((t-(t0+gap))/gap); % return the integer valve

% if( n*gap<=(t-(t0+gap)) && (t-(t0+gap))< 2*n*gap)
%% end

if((t)<(Vm/a1) && k>=0)
    k= a1*((t));
    dis1=0.5*a1*((t))*((t));
    f=(210.93*a1*1000+191.75*20)*k/1000000;
    dis2=d-(0.5*a1*((t))*((t)));
elseif(((Vm/a1)<=t)&&((t)<((Vm/a1+(d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm))&& k>=0)
    k= Vm;
    dis1=0.5*a1*(Vm/a1)*(Vm/a1) + Vm*((t)-Vm/a1);
    f=(191.75*20)*k/1000000;
    dis2=d-(0.5*a1*(Vm/a1)*(Vm/a1) + Vm*((t)-Vm/a1));
elseif(((Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm)<=t)&&
((t)<(Vm/a1+Vm/a2+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))&& k>=0)
    k= Vm - (a2*(t-(Vm/a1+(d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)));
    dis1=0.5*a1*(Vm/a1)*(Vm/a1) + Vm*((d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)+Vm*(t-(Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))-
0.5*a2*((t-(Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))^2);
    f=(-210.93*a1*1000+191.75*20)*k/1000000;
    dis2=d-(0.5*a1*(Vm/a1)*(Vm/a1) + Vm*((d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)+Vm*(t-(Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))-
0.5*a2*((t-(Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))^2));
end;
if dis1>=(d-0.0001)
    stal=1;
else
    stal=0;
end
% a=a+300;
else
    stal=0;
end
t1=t0+gap+(Vm/a1+Vm/a2+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm);
u=k;
p=f;
y1=dis1;
y2=dis2;

st1=stal;

end

```

ANNEXURE G- MATLAB Code for the Train Model which does not reach the maximum speed

```

function [u,y1,y2,p,st1,t1]= fcn(time,t,a1,a2,Vm,d,gap,t0)
k=0;
dis1=0;
dis2=0;
f=0;
if(time>(t0+gap))

% n = fix((t-(t0+gap))/gap); % return the integer valve

% if( n*gap<=(t-(t0+gap)) && (t-(t0+gap))< 2*n*gap)
%% end

if((t)<(Vm/a1) && k>=0)
    k= a1*((t));
    dis1=0.5*a1*((t))*((t));
    f=(210.93*a1*1000+191.75*20)*k/1000000;
    dis2=d-(0.5*a1*((t))*((t)));

elseif(((Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm)<=t)&&
((t)<(Vm/a1+Vm/a2+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))&& k>=0)
    k= Vm - (a2*(t-(Vm/a1+(d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)));
    dis1=0.5*a1*(Vm/a1)*(Vm/a1) + Vm*((d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)+Vm*(t-(Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))-
0.5*a2*((t-(Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))^2);
    f=(-210.93*a1*1000+191.75*20)*k/1000000;
    dis2=d-(0.5*a1*(Vm/a1)*(Vm/a1) + Vm*((d -0.5*Vm*Vm/a2-
0.5*Vm*Vm/a1)/Vm)+Vm*(t-(Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))-
0.5*a2*((t-(Vm/a1+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm))^2));
end;

if dis1>=(d-0.0001)
    stal=1;
else
    stal=0;
end

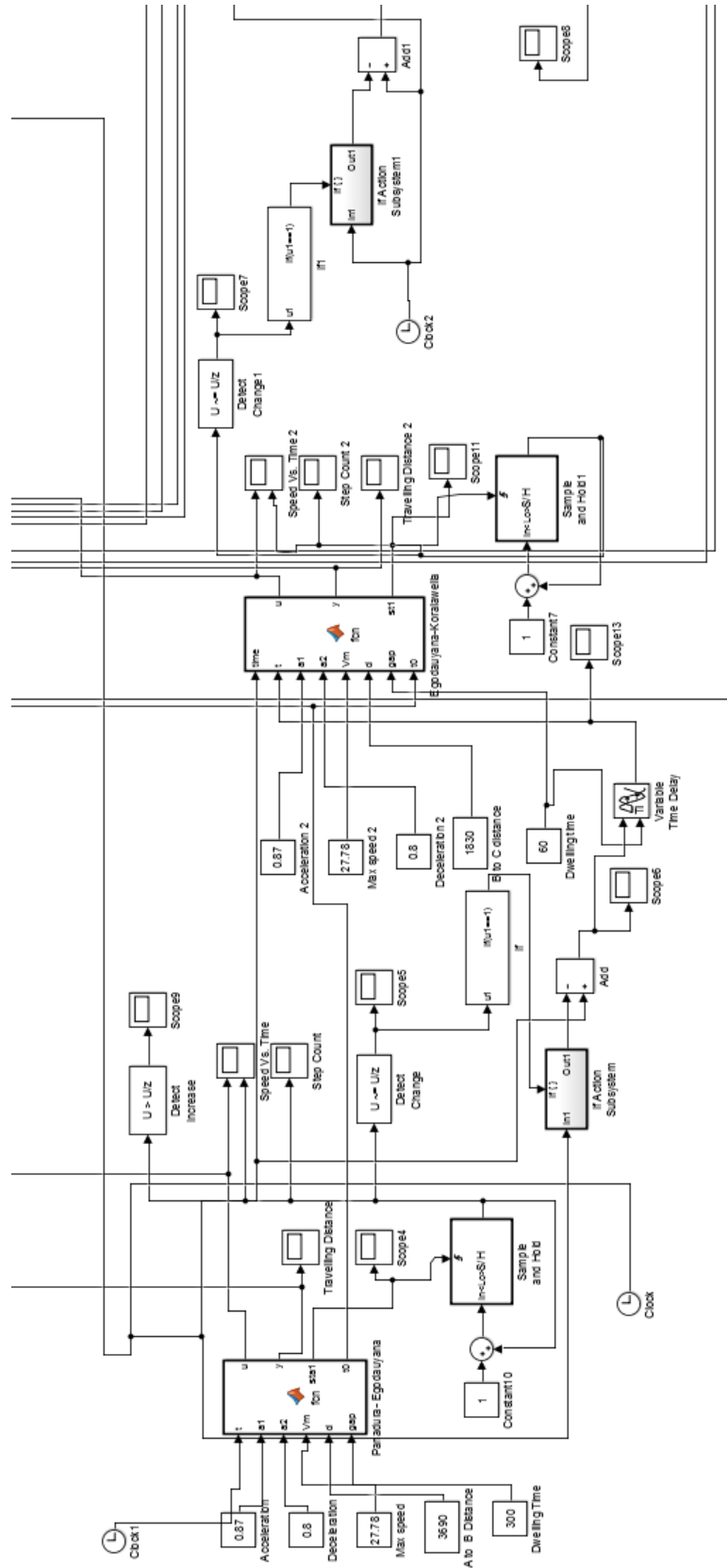
% a=a+300;
else
    stal=0;
end

t1=t0+gap+(Vm/a1+Vm/a2+(d -0.5*Vm*Vm/a2-0.5*Vm*Vm/a1)/Vm);
u=k;
p=f;
y1=dis1;
y2=dis2;
st1=stal;

end

```

ANNEXURE H – MATLAB Model for Train Movement



ANNEXURE I – Specification for Scott-T Transformer

1LIN600205-GGG, Rev-B, 08.08.16
Page 1 of 14

ANNEXURE-3
SCHEDULE OF GUARANTEED PERFORMANCE, TECHNICAL AND OTHER PARTICULARS
(GUARANTEED PARTICULARS ARE TO BE ESTABLISHED BY ACTUAL TESTS/TEST REPORTS)

| SR NO | DESCRIPTION | UNIT OF MEASUREMENT | VALUE/INFORMATION |
|----------|--|---------------------|---|
| 1 | 2 | 3 | 4 |
| A | RATINGS/ PARTICULARS | | |
| 1 | Name of the Manufacturer | | ABB India Ltd |
| 2 | Country of Manufacturer | | INDIA |
| 3 | Reference to specification based on which performance data is prescribed | | ET/PSI/118(10/83) with A&C Slip no. 1 to 10 |
| 4 | Rated Power | MVA | 21.6 / 30.24 |
| 5 | Primary current at: | | ONAN / ONAF |
| | i) Rated load | A | 163.63 / 229.1 |
| | ii) 150% rated load for 15 min. | A | 245.45 / 343.65 |
| | iii) 200% rated load for 5 min. | A | 327.27 / --- |
| 6 | Secondary current at: | | |
| | i) Rated load | A | 800 / 1120 |
| | ii) 150% rated load for 15 min. | A | 1200 / 1680 |
| | iii) 200% rated load for 5 min. | A | 1600 / -- |
| 7 | Rated Voltage: | | |
| | i) Primary | kV | 132 |
| | ii) Secondary (at no-load) | kV | 27 |
| 8 | Rated frequency | Hz | 50 ± 3% |
| 9 | Temperature rise above ambient temp. of 50 Deg.C | | |
| 1 | Oil: | | |
| | i) At rated load | Deg C | 40 max. |
| | ii) At 150% rated load load for 15 min. | Deg C | 40 max. |
| | iii) At 200% rated load for 5 min. | Deg C | 40 max. |
| 2 | Winding: | | |
| | i) At rated load | Deg C | 50 (Max.) |
| | ii) At 150% rated load load for 15 min. | Deg C | 60 (Max.) |
| | iii) At 200% rated load for 5 min. | Deg C | 60 (Max.) |
| 10 | Hot-Spot temperature of winding over ambient temperature of 50 Deg.C | | |
| | i) At rated load | Deg C | 65(Max.) |
| | ii) At 150% rated load load for 15 min. | Deg C | 65(Max.) |
| | iii) At 200% rated load for 5 min. | Deg C | 65(Max.) |

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For Director General/T.I./R.B.S.O./LKO/25/11/17



ANNEXURE-3

SCHEDULE OF GUARANTEED PERFORMANCE, TECHNICAL AND OTHER PARTICULARS
(GUARANTEED PARTICULARS ARE TO BE ESTABLISHED BY ACTUAL TESTS/TEST REPORTS)

| SR NO | DESCRIPTION | UNIT OF MEASUREMENT | VALUE/INFORMATION |
|---|--|---------------------|-------------------|
| Note : Overloading Condition ONAN Rating - 150% of rated load for 15 Min. & 200% of rated load for 5 Min. ONAF Rating - 150% of rated load for 15 Min. | | | |
| 11 | Interval of time between two successive overloads after continuous working at full load at maximum ambient temperature of 50 Deg.C | | |
| | i) Between two consecutive overloads of 50% for 15 min. | | 3 HOURS(APPROX.) |
| | ii) Between two consecutive overloads of which one is of 50% for 15 min. and the other of 100% for 5 min. | | 3 HOURS(APPROX.) |
| 12 | No-load current referred to primary side at rated frequency and at: | | |
| | i) 90% rated voltage | A | 0.2(APPROX.) |
| | ii) Rated Voltage: | A | 0.3(APPROX.) |
| | iii) 110% rated voltage | A | 0.45(APPROX.) |
| | iv) Appropriate Voltage at 15% tap | A | 0.4(APPROX.) |
| | v) Appropriate Voltage at +10% tap | A | 1.2(APPROX.) |
| 13 | Power Factor of no-load current at rated voltage and rated frequency | | 0.3(APPROX.) |
| 14 | Value of the inrush current at rated voltage on primary side, the secondary side being open circuited | A | 1050 Approx. |
| 15 | Losses: | | |
| | i) No-load loss at rated frequency and at: | | |
| | 1) 90% rated voltage at the principal tapping | KW | 7.5(APPROX.) |
| | 2) rated voltage at the principal tapping | KW | 9 (MAX) |
| | 3) 110% rated voltage at the principal tapping | KW | 11.8 (APPROX.) |
| | 4) Appropriate voltage at the -15% tap | KW | 7.0 (APPROX.) |
| | 5) Appropriate voltage at the +10% tap | KW | 11.8 (APPROX.) |
| | ii) Load loss (at 75 Deg.C) with rated current and frequency @ 21.6 MVA | | |
| | 1) Principal tapping | KW | 80 (MAX) |
| | 2) -15% tapping | KW | 107 (APPROX.) |
| | 3) +10% tapping | KW | 74 (APPROX.) |
| | iii) Total losses at rated current and frequency: | | |
| | 1) Principal tapping | KW | 89 (MAX.) |
| | 2) -15% tapping | KW | 114 (APPROX.) |
| | 3) +10% tapping | KW | 85.8 (APPROX.) |
| 16 | Resistance voltage (at 75 Deg.C) at rated current at principal tapping: | | |
| | i) Primary | % | 0.163(APPROX.) |
| | ii) Secondary | % | 0.153(APPROX.) |

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For Director General/T.A./R.S.O./LKO



ANNEXURE-3

**SCHEDULE OF GUARANTEED PERFORMANCE, TECHNICAL AND OTHER PARTICULARS
(GUARANTEED PARTICULARS ARE TO BE ESTABLISHED BY ACTUAL TESTS/TEST REPORTS)**

| SR NO | DESCRIPTION | UNIT OF MEASUREMENT | VALUE/INFORMATION |
|-------|--|---------------------|-------------------|
| 17 | Reactance voltage at 75 Deg.C at rated current and frequency at principal tapping: | % | 11.99(APPROX.) |
| 18 | Impedance voltages (at 75 Deg.C) at rated current and frequency at 21.6MVA : | | |
| | i) Principal tapping | % | 12(+/- 0.5% TOL) |
| | ii) -15% tapping | % | 12.0 Approx. |
| | iii) +10% tapping | % | 12.0 Approx. |
| 19 | Resistance at (75 Deg.C) of primary winding | Ohm | 1.40(APPROX.) |
| 20 | Resistance (at 75 Deg.C) of secondary winding at: | | |
| | i) Principal tapping | Ohm | 0.058(APPROX.) |
| | ii) +10% tapping | Ohm | 0.050(APPROX.) |
| | iii) -15% tapping | Ohm | 0.075(APPROX.) |
| 21 | Reactance of winding: | | |
| | i) Primary | H | 1.538(APPROX.) |
| | ii) Secondary at: | | |
| | 1) Principal tapping | H | 0.055(APPROX.) |
| | 2) +10% tapping | H | 0.0307(APPROX.) |
| | 3) -15% tapping | H | 0.070(APPROX.) |
| 22 | Regulation (at 75 Deg.C) with rated current and at power factor of: | | |
| | i) Unity | % | 1.09 |
| | ii) 0.8 lagging | % | 7.93 |
| 23 | Efficiencies: | | |
| | i) Efficiency (at 75 Deg.C) at unity power factor at: | | |
| | 1) 100% load | % | 99.59 |
| | 2) 75% load | % | 99.67 |
| | 3) 50% load | % | 99.73 |
| | 4) 25% load | % | 99.74 |
| | ii) Efficiency (at 75 Deg.C) at .8 power factor lagging at: | | |
| | 1) 100% load | % | 99.49 |
| | 2) 75% load | % | 99.59 |
| | 3) 50% load | % | 99.67 |
| | 4) 25% load | % | 99.66 |
| | iii) Percentage of rated load at % which maximum efficiency occurs. | % | 33.541 |

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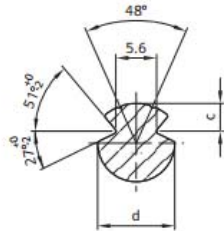
For Director General/T.I./R.D.S.O./LRO.



ANNEXURE J - Catenary Cable Guide

Grooved contact wire AC, CuAg0.1

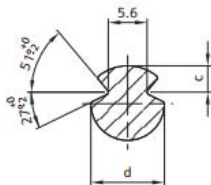
acc. to EN 50149



| Order no. | 8WL7000-1 | 8WL7001-1 | 8WL7002-1 | 8WL7003-1 |
|----------------------------|------------------------|------------------------|------------------------|------------------------|
| Designation | Contact wire AC-80 | Contact wire AC-100 | Contact wire AC-120 | Contact wire AC-150 |
| Material | CuAg0.1 | CuAg0.1 | CuAg0.1 | CuAg0.1 |
| Weight | 0.71 kg/m | 0.89 kg/m | 1.07 kg/m | 1.33 kg/m |
| Nominal cross-section | 80 mm ² | 100 mm ² | 120 mm ² | 150 mm ² |
| Min. tensile strength | 365 N/mm ² | 360 N/mm ² | 350 N/mm ² | 350 N/mm ² |
| Min. breaking load | 28.3 kN | 34.9 kN | 40.7 kN | 50.9 kN |
| Perm. permanent current | 620 A | 705 A | 750 A | 875 A |
| Resistance at 20 °C | 0.22 Ω/km | 0.18 Ω/km | 0.15 Ω/km | 0.12 Ω/km |
| Conductivity at DC (20 °C) | 56 m/Ω mm ² | 56 m/Ω mm ² | 56 m/Ω mm ² | 56 m/Ω mm ² |
| c | 3.8 mm | 4.0 mm | 4.0 mm | 4.0 mm |
| d | 10.6 mm | 12.0 mm | 13.2 mm | 14.8 mm |

Grooved contact wire AC, Cu-ETP

acc. to EN 50149



| Order no. | 8WL7000-0 | 8WL7001-0 | 8WL7004-0 | 8WL7002-0 | 8WL7003-0 |
|----------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Designation | Contact wire AC-80 | Contact wire AC-100 | Contact wire AC-107 | Contact wire AC-120 | Contact wire AC-150 |
| Material | Cu-ETP | Cu-ETP | Cu-ETP | Cu-ETP | Cu-ETP |
| Weight | 0.71 kg/m | 0.89 kg/m | 0.95 kg/m | 1.07 kg/m | 1.33 kg/m |
| Nominal cross-section | 80 mm ² | 100 mm ² | 107 mm ² | 120 mm ² | 150 mm ² |
| Min. tensile strength | 355 N/mm ² | 355 N/mm ² | 350 N/mm ² | 330 N/mm ² | 310 N/mm ² |
| Min. breaking load | 27.5 kN | 34.5 kN | 36.3 kN | 38.4 kN | 45.1 kN |
| Perm. permanent current | 370 A | 455 A | 468 A | 490 A | 540 A |
| Resistance at 20 °C | 0.22 Ω/km | 0.18 Ω/km | 0.17 Ω/km | 0.15 Ω/km | 0.12 Ω/km |
| Conductivity at DC (20 °C) | 57 m/Ω mm ² | 57 m/Ω mm ² | 57 m/Ω mm ² | 57 m/Ω mm ² | 57 m/Ω mm ² |
| c | 3.8 mm | 4.0 mm | 4.0 mm | 4.0 mm | 4.0 mm |
| d | 10.6 mm | 12.0 mm | 12.3 mm | 13.2 mm | 14.8 mm |

ANNEXURE K – Single Line Diagram for Traction Substation at Ratmalana

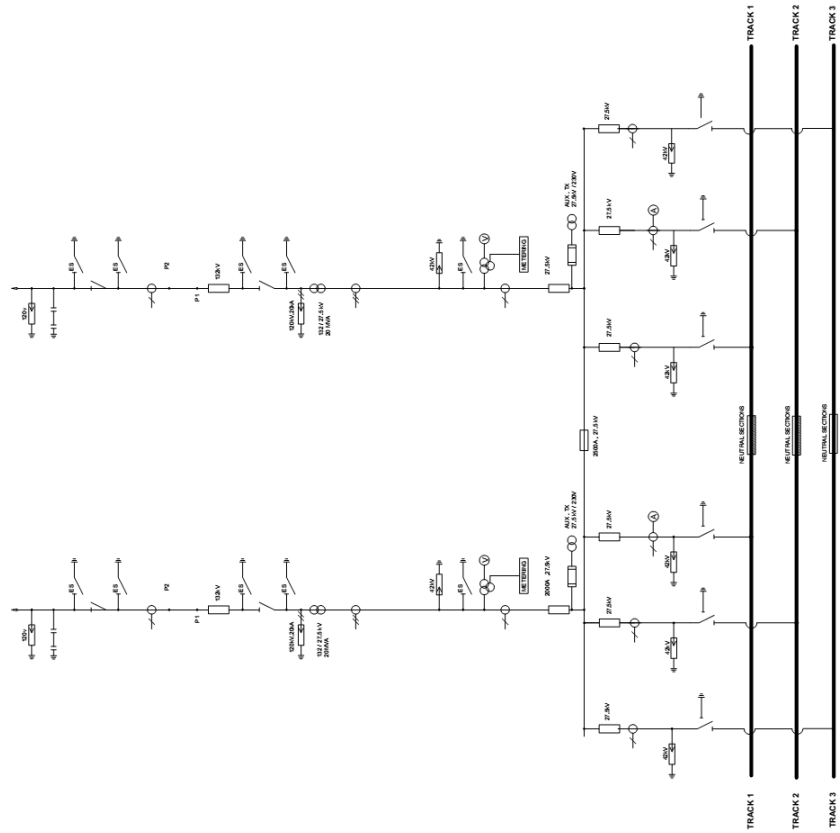
SIMPLIFIED INDICATIVE SINGLE LINE DIAGRAM

LEGEND :

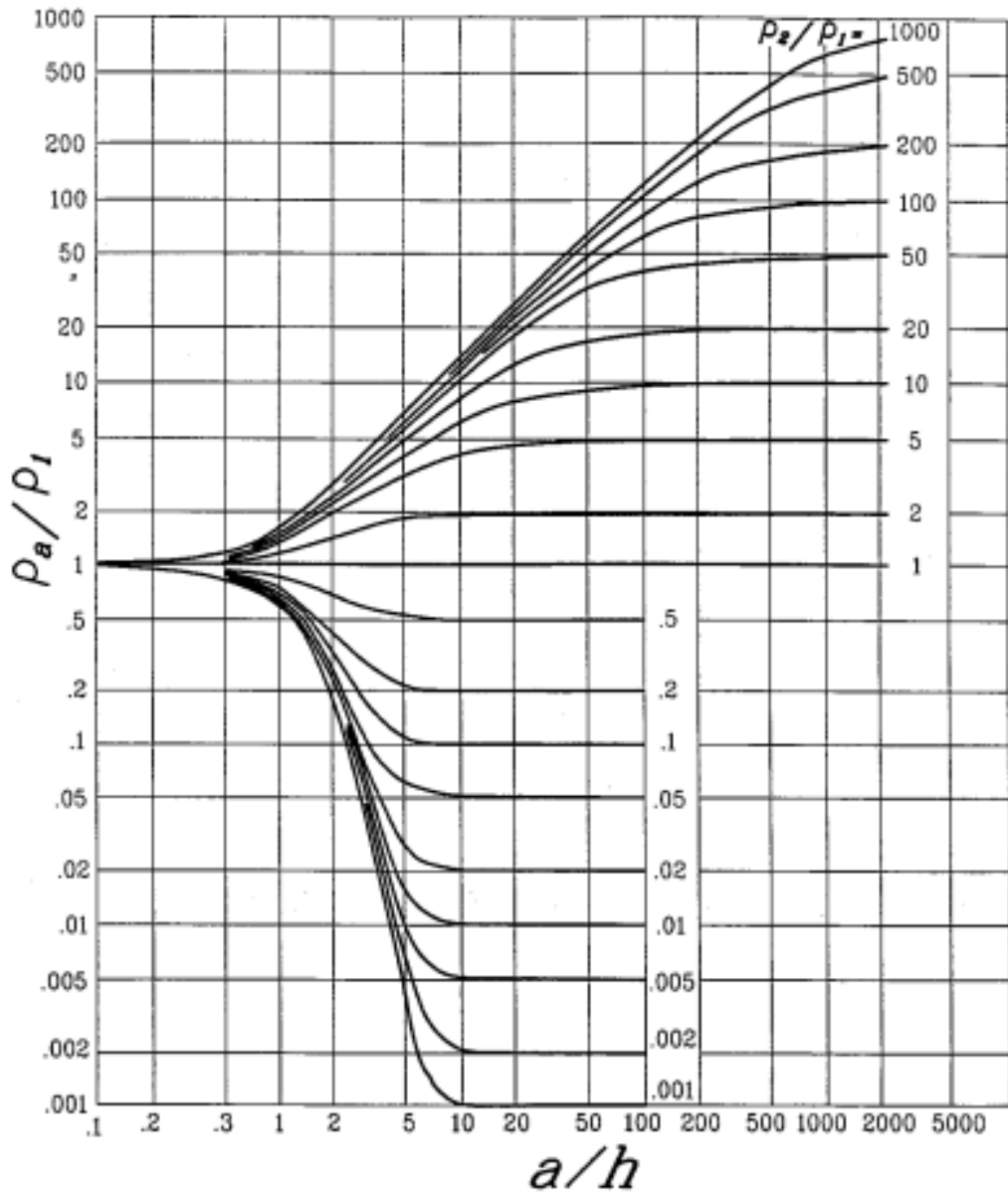
| SYMBOL | DESCRIPTION |
|--------|---|
| | PHASE INDICATORS |
| | CIRCUIT BREAKER |
| | CURRENT TRANSFORMER |
| | CAPACITOR VOLTAGE TRANSFORMER |
| | ISOLATOR WITH SES |
| | 25kV THREE POSITION ISOLATOR |
| | POWER TRANSFORMER |
| | EARTHING SPIKE |
| | POTENTIAL TRANSFORMER |
| | 25kV VOLTAGE TRANSFORMER WITH MUTUAL INDUCTANCE |
| | AMMETER |
| | VOLTMETER |
| | ELECTRICAL INTERLOCKING |
| | RELAY OPERATOR |
| | 25kV ISOLATOR |
| | ISOLATOR |

INCOMING CEB 132kV CIRCUIT 2

INCOMING CEB 132kV CIRCUIT 1



ANNEXURE M - Sunde's Graphical Method



**ANNEXURE N – Earth Grid Arrangement for Proposed Traction Substation
at Ratmalana**