

11 Appendix B – Train Performance Calculator

11.1 Intro

The Train Performance Calculator (TPC) was created to perform all the calculations needed in this report rapidly with high precision. Much effort has been invested in creating the TPC due to the amount of calculations needed and the number of formulas and connections, however the result is in the view of the Author a decent tool that can be used for simple train performance calculations. The tool is able to evaluate different types of rolling stocks and signalling system impact and can calculate simple, theoretical values of rolling stock performance, capacity and infrastructure elements.

The TPC assumes that the user has the necessary rolling stock and infrastructure data available.

The TPC comes in two versions, the first is the original unprotected Excel workbook with all formulas and sheets available and modifiable. This version is to be used when evaluating the TPC. The second version is the protected version where only the cells and sheets that is needed for the end user is available. This version is intended to be the final end-user version of the calculator.

All the formulas and calculations in the TPC are all based on the assumptions and equations found in this dissertation. It is only valid for a small section of the railway and it does not consider external factors.

11.2 How to use the TPC

There are three tabs for this worksheet which are of interest for the end-user, “Input”, “Graphs” and “Signalling”. In the Input tab the user can change the data after requirements. Those cells which are locked are results of the inputs, and cannot therefore be edited. However, a shot description is available in the following sections

11.3 Input

Performance Characteristics

Here the rolling stock performance characteristics are typed in as given by the rolling stock manufacturer for both EMU1 and EMU2. EMU2 must have better performance values than EMU1 to get the calculations to function correctly. However, the Mechanical resistance is assumed to be 10N per ton and therefore it is locked. Also, the maximum speed and acceleration and the calculation step is locked.

Acceleration Performance

This is a comparison between the EMU1 and EMU2 of acceleration in time and distance for a given speed range. They are also compared against each other at the same point of travel to reflect the true performance difference between the two trains. Only the speed range is available for editing.

Infrastructure Characteristics

In this part all cells are locked except the “Choose signalling type”. Based on the signalling type all the values will change based on the selection except the turnout section length which is locked to 270m (this will not affect the calculation significantly, but is required to simulate high speed turnouts).

Performance Characteristics		EMU1	EMU2
Rotating Mass Factor	f_p	1,06	1,06
Maximum Starting Force	F_{max} kN	300	400
Total Mass of Train	m tonne	445	400
Power of all Motors	P kW	9000	12000
Mechanical Resistance	r_0 kN	4,45	4,00
Viscous Mechanical Resistance	r_1 kN s /m	0,060	0,055
Aerodynamic Resistance	r_2 kN s ² /m ²	0,0075	0,0065
Maximum Speed	V_{max} m/s	101,80	118,20
Maximum Acceleration	a_{max} m/s ²	0,66	0,99
Average Deceleration	a_b m/s ²	0,70	0,70
Train Length	$S-TL$ m	200	200
Grade	α %	0,00	0,00
Calculation Accuracy (Speed Interval)		0,10	

Acceleration Performance		From	To
Speed Range	m/s ²	44,4	97,2
Distance Travelled	m	37796,8	15251,6
Time Spent	s	463,4	197,4
Distance to reach same point	m		22545,2
Time difference at same point	s	+34,1	

Infrastructure Characteristics		Value
Choose signalling type		Aspect
Route Formation	t_{RF} s	Aspect
Visual Distance	t_{VD} s	ATO
Route Release	t_{RR} s	ERTMS L2
Buffer Time	t_{BT} s	ERTMS L3
Overlap Length	s_{OL} m	3
Turnout Section Length	s_{TS} m	180
		200
		270

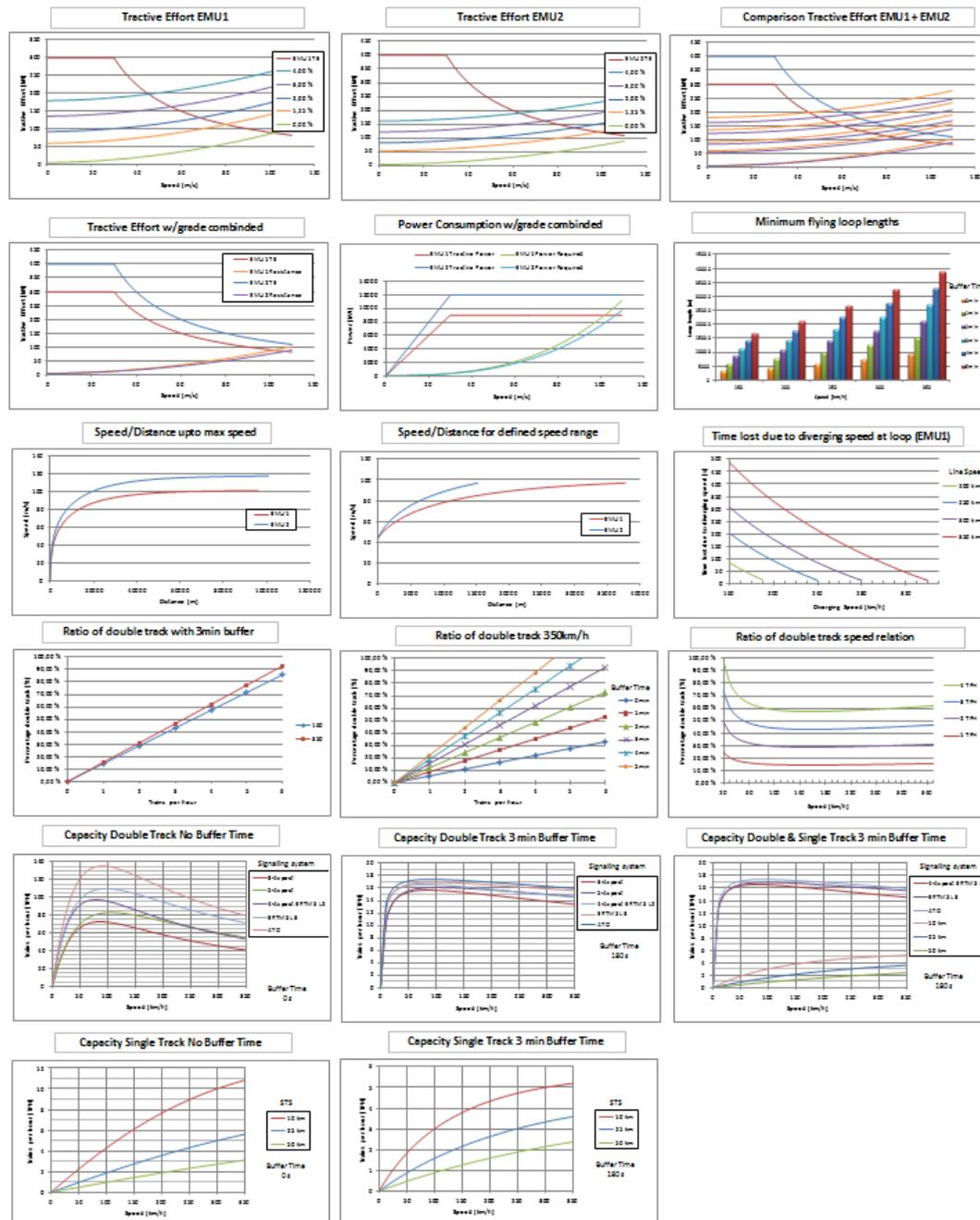
11.4 Signalling

The signalling tab is to adjust the values for each signalling system used in the Infrastructure Characteristics table in the Input tab. The parameters adjusted in this section will automatically be updated in all calculations.

		Aspect	ATO	ERTMS L2	ERTMS L3	ST
t_{RF}	Route Formation [s]	5	5	6	6	10
t_{VD}	Visual Distance [s]	8	1	5	5	8
t_{RR}	Route Release [s]	3	3	3	3	3
t_{BT}	Buffer Time [s]	180	180	180	180	180
s_{OL}	Overlap Length [m]	200	20	50	50	200

11.5 Graphs

In this tab all the result based on the calculations are displayed in various graphs, which can be found in this dissertation. This is only an output tab and does not allow for any input.



11.6 All other tabs

All other tabs are meant only to be used to review the calculations done and should not be edited.