

Appendix B: Specification of the Trip Time Calculation

This appendix shall be a recommendation for the calculation of trip times by the Contractors in order to receive comparable results. It shall be a basis for internal discussions.

For generating comparable trip time calculations the important parameters are to be clearly defined. Besides the track data (inclination, curve radiuses, station positions, maximum speed) and the operation data (environmental data, station positions, residence time), the driving resistance data of the train are the necessary parameters.

The train driving resistance F_{wz} shall be calculated according to equation 1.

The driving resistance of the Dual-Loco F_{wL} should be considered by the use of equation 2, but if the Contractor has a more precise equation he may use it (differences are to explain).

The driving resistance of the coaches F_{wW} are to calculate according to equation 3 with the specific driving resistance f_{wW} according to equation 4.

The curve radius resistance is to be respected according to equation (5).

Resistance	force	train:
	$F_{wz} = F_{wL} + F_{wW}$	[kN] (1)

Resistance	force	locomotive:
	$F_{wL} = f_{wL0} G_L + F_{wL2} \left(\frac{v + \Delta v}{v_{00}} \right)^2$	[kN] (2)

G_L : weight of locomotive [kN]

v : velocity [m/s or km/h]

Δv : velocity addition [m/s or km/h] (headwind)

$v_{00} = 100$ km/h respectively 27.778 m/s: velocity constant

Resistance	force	coaches:
	$F_{wW} = f_{wW} G_{wW}$	[kN] (3)

G_{ww} : weight of coaches [kN]; all coaches; fully loaded

Resistance force equation coaches (Sauthoff):

$$f_{ww} = f_{ww0} + f_{ww1} \left(\frac{v}{v_{00}} \right) + f_{ww2} \left[\frac{(v + \Delta v)}{v_{00}} \right]^2 \quad [-] \quad (4)$$

Curve radius resistance (according to Röckl):

$$F_R = \frac{k}{R - \Delta R} \cdot (G_L + G_w) \quad [\text{kN}] \quad (5)$$

R: curve radius [m]

$R < 300\text{m}$: $\Delta R = 30\text{m}$; $3000 > R \geq 300 \text{ m}$: $\Delta R = 55 \text{ m}$

$R < 300\text{m}$: $k = 0.500 \text{ m}$; $3000 > R \geq 300 \text{ m}$: $k = 55 \text{ m}$

(for reference see: Fahrdynamik des Schienenverkehrs; Dietrich Wende; 1. Auflage 2003)

For vehicle comparison the trip time Tel Aviv Hagana – Jerusalem Binyanei Hauma without intermediate stops will be used.

The following table shows the parameters that are to be used for the calculation.

Parameter	Description	Value
Train configuration:	Dual-Loco+6 Double Deck Push Pull coaches (5xTC+PC) DDPP-train	6 coaches+Dual - Loco
Mass of coaches; m_w :	fully loaded without Dual-Loco	325.00 t
Effective mass by moment of inertia; m_{DW} :	$(0.6\text{t}+3 \times 0.05\text{t}) \times 4 \times 6$ coaches	18.00 t
Base resistance coaches; f_{ww0} :	double deck coaches	0.002
Bogie resistance coaches; f_{ww1} :	running gear resistance	0.000715
Aerodynamic resistance coaches; f_{ww2} :	double deck coaches	0.00364
Δv	headwind	10 km/h
Outside temperature		37 ° C
Route definition:	slope; distance, curve radius, limit speed; etc.	see table

Parameter	Description	Value
Number of stops; n_H :	none, calculate trip time without stop at Ben Gurion Airport	none
Altitude above MSL	see track data	see table

Table B-1: Relevant data of reference train for calculating the trip times

The Contractor shall provide the used traction braking effort curves as well as the used efficiency and energy consumption curves.

All calculations must be presented and explained in a way which is comprehensible and fully enables recalculating and reproducing all data.

For track data for the calculation please refer to the following table.

Horizontal plan

Length of section [m]	Curve radius [m] (0=straight)	Direction [L/R]
Startpoint	Tel Aviv Hagana	
102.43	508	L
191.68	1900	L
139.64	0	
304.79	445	L
163.21	0	
110.02	445	R
481.42	0	
300.00	645	L
130.00	0	
170.00	645	L
2846.00	0	
127.00	3500	R
61.00	0	
127.00	3500	L
449.15	0	
33.82	3600	R
998.00	0	
1.547.93	1600	L
870.08	0	
907.76	679.5	R
357.25	0	
399.86	600	L
480.34	0	
171.22	3000	R
90.81	0	
171.78	1000	L
387.02	0	
414.07	854.7	R
561.37	0	
411.64	900	L

413.96	0	
657.38	804.7	R
294.07	0	
291.67	2004.7	R
660.26	0	
207.41	5004.7	R
990.70	0	
626.47	1600	L
162.32	0	
378.84	1600	L
673.72	0	
1.149.41	2004.7	R
252.39	0	
250.21	3004.7	R
760.19	0	
501.20	1600	L
830.34	0	
347.55	1600	L
1.301.77	0	
562.47	1504.7	R
607.47	0	
911.20	1997.65	L
640.56	0	
1.452.36	3497.65	L
1.027.05	0	
824.00	1997.65	L
39.16	0	
556.78	2002.35	R
310.05	0	
1.222.52	2000	R
1.910.18	0	

1.346.62	2000	L
924.34	0	
774.37	4000	L
5.052.09	0	
435.96	2500	L
2.397.55	0	
326.07	4000	L
4.291.88	0	
1.572.73	1510	R
696.94	0	
704.68	1197.65	L
113.41	0	
282.55	802.35	R
353.87	0	
60.05	700	L
70.03	0	
227.90	400	L
423.52	0	
Destination	Jerusalem Binyanei Hauma	

Vertical plan

Length of section [m]	Gradient [%]
Tel Aviv Hagana	
93.19	0.56
622	5.72
41	5.29
112	2.77
38	1.5
212	0
125	1.86
175	4.17
188	7.32
400	0
196	1.16
0	0
200	1.16
1300	2
475	0
825	1.7
250	2
100	1
300	1.5
174	3.7
0	0
135	3.7
143	2.39
297	-7.48
275	-15
1050	-4.48

Length of section [m]	Gradient [%]
300	4.6
1005	13.72
670	5.22
195	0
465	-15.05
265	-2.83
390	1.92
260	0
205	2
175	5.36
401	8.5
147	10.93
227	20.56
320	2.48
75	4.92
385	5.74
200	8.2
400	22
465	9
534	-4
416	8
300	0
550	-13
200	-6
210	7
950	11
250	0

Length of section [m]	Gradient [%]
315	-7
350	-3
355	-3.6
465	0
870	7
1510	12.5
255	4
420	0
300	8
253	20
447	24
295	14.5
305	12.2
759.67	7.49
335.24	15.64
1464.15	-1.29
879.85	3.77
799.47	22.14
2574.23	8.56
290.27	18
2113.91	28.95
3517.66	25.05
1648.03	21.5
12603.36	25.03
1201.54	18.96
1349.43	30
511.38	13.1

Length of section [m]	Gradient [%]
499.7	2.02
Jerusalem Binyanei Hauma	

Speed Profile:

<i>V-max (km/h)</i>	<i>Lenght(m)</i>	<i>Begin absolute location (m)</i>
60	1493.19	0
80	709	1493.19
150	3501.15	2202.19
140	123.3	5703.34

<i>100</i>	<i>400</i>	<i>5826.64</i>
<i>150</i>	<i>2926.54</i>	<i>6226.64</i>
<i>100</i>	<i>5424.46</i>	<i>915318</i>
<i>160</i>	<i>37560.87</i>	<i>14577.64</i>
<i>120</i>	<i>818.09</i>	<i>52138.51</i>
<i>100</i>	<i>636.42</i>	<i>52956.6</i>
<i>70</i>	<i>130.08</i>	<i>53593.02</i>
<i>50</i>	<i>651.42</i>	<i>53723.1</i>
<i>0</i>		<i>54374.52</i>