Review the Journey Time Test Result for Johnsonville Line with Current Restricted Speed

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REVISION HISTORY

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1. General

This document is to review the result of journey time test as comparison the measured journey time with the simulated data due to non satisfaction of the test result in Johnsonville line.
So RM simulate the journey time for Johnsonville line as applying the current restricted speed.
And we compare the simulated data with the test result and analyze the test result.

2. Relevant Documents

1) REFERENCE NUMBER : RM\1A-03-01-01\D0017\R02
   - DOCUMENT TITLE : Configuration of Propulsion System
2) REFERENCE NUMBER : RM\1A-03-01-01\D0019\R04
   - DOCUMENT TITLE : Running Simulation
3) REFERENCE NUMBER : RM\1A-03-01-01\D0018\R04
   - DOCUMENT TITLE : Train Performance
4) REFERENCE NUMBER : RM\1A-05-06-01\D0007
   - DOCUMENT TITLE : TEST REPORT FOR WEIGHING
5) REFERENCE NUMBER : RM\1A-03-01-01\D0023
   - DOCUMENT TITLE : The Specification of Traction Motor For Wellington EMU

3. Journey Time Simulation for Johnsonville Line

RM simulate the journey time for Johnsonville line as applying the current restricted speed. And we compare the simulated data for SDR stage with the simulating data of journey time applied in current restricted speed.

3.1 Condition for Simulation

1) Train formation Tc + Mc
2) Car weight

The car weight is applied in the test result (RM\1A-05-06-02\D0007, 'TEST REPORT FOR WEIGHING TEST)

	Passenger[kg] (Num. of Passenger)		Tc car [kg]	Mc car [kg]	Total weight [kg]	Remark
	Tc car	Mc car				
Tare load (AW0)	0 (0)	0 (0)	33,629	41,120	74,748	
Seated load (AW1)	5,550 (74)	5,850 (78)	38,809	46,580	85,388	
Peak load (AW2)	9,413 (126)	9,340 (125)	42,499	49,870	92,318	

	Passenger[kg] (Num. of Passenger)		Tc car [kg]	Mc car [kg]	Total weight [kg]	Remark
	Tc car	Mc car				
Crush load (AW3)	11,610 (155)	11,325 (151)	44,479	51,690	96,168	For simulation
Max. load (AW4)	14,640 (195)	14,063 (188)	47,279	54,280	101,558	

* The calculated standee area is Tc(20.2m^2) and Mc(18.25m^2) according to General arrangement – option X.

3) Wheel diameter 820 mm (for calculation)
860 mm (new wheel)

4) Traction Motor Capacity 170kW

5) Acceleration rate 0.83 m/s^2 form 0 km/h to 35km/h
This value is proposed by RM for energy saving and safety.

6) Deceleration rate 0.9m/s^2 in dry and on level track condition

7) OHW voltage DC 1500V for powering
DC 1650V for regenerative braking

8) Rotating inertia coefficient Tc car : 5%, Mc car : 10%

9) Running resistance - Open area

$$R = \{(1.65+0.0247\times V)\times Wm + (0.78+0.0028\times V)\times Wt + (0.028+0.0078(n-1))\times V^2\}\times 9.8 \text{ [N/train]}$$

Here, Wm : Mass of Mc car[tons]
Wt : Mass of Tc car[tons]
n : number of cars
V : Train speed[km/h]

- Tunnel area

$$R = \{18.29+0.3518\times V+0.007301\ V^2\} \times W_{TOTAL} \text{ [N/train]}$$

Here, V : train speed[km/h]
W_{TOTAL} : Mass of Train

* This formula is Korea standard. And this has been applied and validated in variable project.

10) Train Performance Apply the defined train performance
in Ref No. RM\1A-03-01-01\D0018\R04
In case of total braking, average deceleration rate : 0.9m/s^2

11) Adhesion coefficient Powering : 18.58%
Only Regenerative Braking : 15.5%

Total Braking (Electrical Brake+ Mechanical Brake) : 18.25%

12) Route for simulation

-. Johnsonville Line

(Wellington station to Johnsonville station, Johnsonville station to Wellington station)

13) Applied Restricted Speed

Portion of Line	Restricted Speed[km/h]
Wellington – 1.5km	60
EXCEPT Between platforms 0.329km and 0.632km	20
1.5km - Johnsonville	50
EXCEPT Between 2.98km and 3.59km, including, Down trains through No.3 turnout and Up train through No.7 turnout, Wadestown.	25
Ngaio, Down train through No.3 turnout and Up train through No.7 turnout	25
Khandallah, Up trains through No.7 turnout.	25
Through all tunnels except the 2.98 to 3.59	40

14) Drive mode All-out mode

3.2 Simulation Result

The simulation result is shown in Table 1. Table 1 contains the total journey time for each route.

Table 1. The simulation result in Johnsonville line

Route	Simulated total journey time in SDR stage (margin %)	Simulated total journey time (margin %)	Typical total journey time	Remark
Wellington to J'ville	00:18:46 (11.3%)	**00:19:41** **(6%)**	00:21:02	
Jville to Wellington	00:18:40 (12.4%)	**00:20:27** **(3%)**	00:21:07	

In simulation result, the margin between simulation result which is applied in new restriction speed and typical total journey time reduce than the simulated journey time in SDR stage due to modification of the restriction speed. The simulated journey meets the typical journey time in all-out mode but this result does not have the room for coasting mode. So we need to adjust the adaptable typical journey time in Johnsonville line.

4. Comparison of Simulated Result and Measured Result for Journey Time

The measured journey time values for Johnsonville line, the simulated journey time and the recommended journey time are shown in Table 2. The two measured journey time values are the measured data in mainline type test and the measured data by H.R. site manager (Mr. B.I. Lee). And we calculate the recommended journey time with 25% margin for considering in measured driver pattern.

And Fig 1 is shown in comparison graph of the simulation data and measuring data with the restricted speed. The measuring data is not achieved to the restricted speed and there is approximate 10km gap between the measured speed and the restricted speed.

Table 2. Comparison for Total Journey Time

Route	Simulated total journey time	Measured total journey time	Measured total journey time by site manager	Recommended journey time
Wellington to J'ville	00:19:41	00:24:23	00:22:19	00:24:36
Jville to Wellington	00:20:27	00:25:27	00:22:07	00:25:34

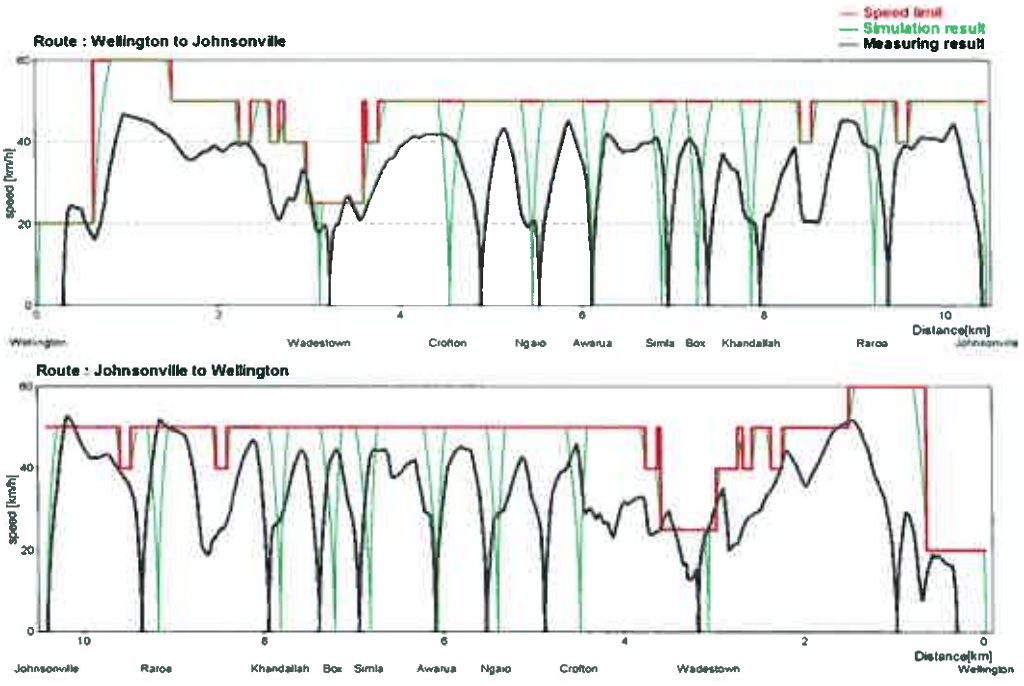

Fig 1. Comparison Graph of Simulation Data and Measuring Data

5. Conclusion

In simulation result, we found the increased journey time due to different of the restricted speed. Also the simulation result applied in new restriction speed does not have sufficient room for typical journey time in the simulation. So we propose to adjust the typical journey time as applying 25% margin.