

틸팅특성과 승차감을 고려한 틸팅열차의 곡선부 제한속도 평가

Evaluation of Speed Limit of Tilting Trains Including Passenger's Comfort in Conventional Line

* * ** ***

Ki-Young Eum, Ju-Hwan Um, In-Ho Yeo, Young-Hwa You

ABSTRACT

For the purpose of speed-up of conventional lines with many curves, the introduction and operation of tilting train is under process. Those are Joong-Ang, Jang-Hang and Ho-nam lines etc. Tilting trains can run a curve section faster than existing trains without a significant violation of passenger's comfort and enable to reduce operating time in the lines with many curves.

In this study, the trains speeds are evaluated, based on the alignment of conventional line, criteria for passenger's comfort and investigated field conditions of the sections where the curves exist. Decision on whether the alignment(transition line) needs to be modified or not is also made. Relative efficiency on curve sections of tilting train to existing trains is approximately 50 % in average.

1.

(KTX)

가

[1,2]

가

가 [3,4]

Fig.1 Fig. 2

가

-
- * 한국철도기술연구원 기존철도기술개발사업단 선임연구원, 정회원
 - ** 한국철도기술연구원 기존철도기술개발사업단 선임연구원, 비회원
 - *** 한국철도기술연구원 기존철도기술개발사업단 위촉선임연구원, 비회원

Table 1

		200 km/h
		180 km/h
		8°
		4 °/sec
	(Tc)	46 tonf
	(M1)	52 tonf
	(M2)	47 tonf
	(W2)	15 tonf
		2,600 mm 3,000 mm
		○ 가 : 1.0 m/s ²
		○ (Jerk) : 0.7 m/s ³
		○ 가 : 0.8 m/s ²
		○ : 5 °/sec
		0.8
		1.2

3.

3.1

[1]

$$(1)$$

, Fig. 3

g

가 (2)

$$f_{rate} = \frac{C_{rate}}{1500} \frac{180}{p} \tag{1}$$

$$a_{lateral} = a_{cen} \cdot \cos a - \sin a \tag{2}$$

$$, a_{cen} = \frac{(V/3.6)^2}{g \cdot R} , a = \tan^{-1} \left(\frac{C}{1500} \right)$$

V = (km/h)

G =

R =

C =

L_{min}

(3)

$$T_{ct} = 3.6 \frac{L_{min}}{V} \quad (3)$$

$$(4) \quad T_d$$

$$T_{tilt} = T_{ct} - T_d \quad (4)$$

$$(5) \quad (6)$$

$$C_{rate} = \frac{C}{T_{ct}} \quad (5)$$

$$CD_{rate} = \frac{CD}{T_{ct}} \quad (6)$$

$$\text{가} \quad \text{가} \quad (7) \quad (8)$$

$$\mathbf{g}_{max} = \tan^{-1} \left(\frac{K_1 \cdot CD}{1500} \right) \quad (7)$$

$$\mathbf{g}_{max_rate} = \frac{\mathbf{g}_{max}}{T_{tilt}} \quad (8)$$

$$(7) \quad K_1 \quad 0.6 \sim 0.7 \quad (9) \quad \text{가}$$

$$(K_2) \quad \text{가} \quad 0.85 \quad (10)$$

$$\mathbf{f}_{rate} = \frac{C_{rate}}{1500} \cdot \frac{180}{p} + K_2 \cdot \mathbf{g}_{max_rate} \quad (9)$$

$$a_{lateral} = a_{cen} \cdot \cos(\mathbf{a} + K_2 \cdot \mathbf{g}_{max}) - \sin(\mathbf{a} + K_2 \cdot \mathbf{g}_{max}) \quad (10)$$

3.2

Table 2

가

가 8

Actuator
5 /sec

가

가

[5]

Table 2

	8 degree
	4 degree/sec
	5 degree/sec
가	0.08g
	5

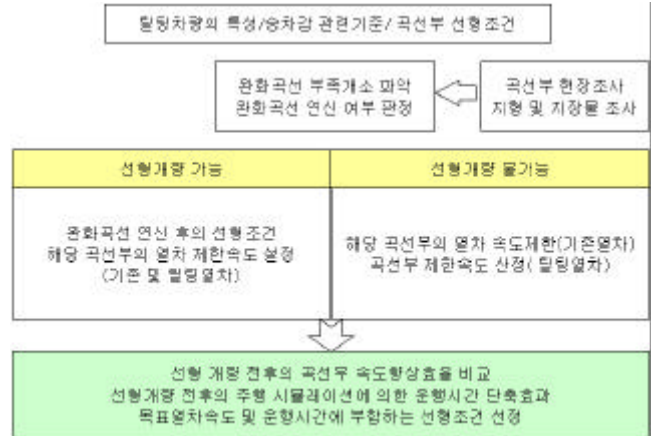


Fig. 4

4.

4.1

가

[6]

가

가

~ (155km)

15% 가

가

가

가

Fig. 4

가

4.2

(~)

, 3

120km/h

(11)

(C),

(R)

(C_d)

[6]

$$V = \sqrt{(C + C_d) / 11.8} \cdot \sqrt{R} \quad (11)$$

$$L = 8.75VC \quad (12)$$

V(km/h)

, C(mm)

3

279mm

, Fig. 5

가

가

가

(, ,)

1000m

Table 4~Table 6

가

가

가

가

가

Table 3

(400m)

R(m)	(mm)	(m)			가			
400	90	65	80	110	×	-	-	/
	90	70	80	112		80	112	-
	90	65	80	110	×	-	-	/
	100	70	80	113		82	113	-
	100	65	73	110		82	113	-
	100	100	82	113		-	-	
	100	70	80	113	×	-	-	가
	100	77	82	113	×	-	-	
	110	65	67	109		84	114	-
	110	65	67	109	×	-	-	가
	110	75	76	115		84	115	-
	120	65	62	109		86	116	-
	120	65	62	109	×	-	-	
	120	65	81	116	×	-	-	

Table 4

(600m)

R(m)	(mm)	(m)			가			
600	70	55	90	118	×	-	-	
	70	60	93	122		93	128	-
	70	60	93	122	×	-	-	
	70	60	93	122	×	-	-	
	80	60	86	122	×	-	-	/
	80	70	96	129		96	135	-
	80	60	86	122		96	135	-
	90	60	76	121		98	140	-
	90	70	89	129		98	137	-

Table 5

(800 1000m)

R(m)	(mm)	(m)			가			
800	60	40	76	115		104	133	-
	60	55	104	129		104	136	-
	60	45	86	120		104	136	-
	70	60	98	134		107	147	-
	80	70	100	141		110	154	-
	80	45	64	119	×	-	-	
	100	60	67	132	×	-	-	
1000	70	35	57	116		120	162	-

) 1000m

- 1) , 가
- 2) , 가 82 , 가 , 142 가
- 3) , 가 가 ,

6.

1. , , 2000.
2. , “ ”, 2000.
3. , “ ”, 2003
4. International Union of Railways, UIC Code 703R, Layout characteristics for lines used by fast passenger trains, Second editions, 1989.
5. International Union of Railways, UIC Code 705 RI, Infrastructure for Tilting Trains, First editions, August 2003.
6. , “ ”, 2001