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Study on the Adaptability of Current Passenger and Cargo Common Line Railway Classification Standards in China

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Abstract

This article refers to the "China Railway Engineering Construction Technical Standards" and "China Railway Technology Management Regulations" and other related norms and literature. Combined with the actual application of China's railway bureaus, this paper analyses the differences of current passenger and cargo common-line railways at all levels in China from the aspects of the main technical parameters, among which the main technical parameters include roadbed and tracks. On the basis of differentiation analysis, the characteristics of the current passenger and cargo common line railway grading standard are summarized, its adaptability and shortcomings are analyzed, and provide a direction for the research and formulation of new passenger and cargo common line railway grading standards, which has certain guiding significance.

Keywords

China Railway; Classification Standards.

1. Introduction

Different levels of passenger and cargo common-line railways not only reflect the difference in passenger and cargo transportation speed and load, but also reflect the different railway construction standards, technical equipment level, maintenance and maintenance and safety management responsibilities. China's current passenger and cargo common line railway grading standards have been gradually formed after 70 years of development, and have made great contributions to the construction, operation and technical development of railways in China. In order to better adapt to the future development trend of China's passenger and cargo common line railway transportation and the sustainability of railway transportation, through this research, this paper provides a more detailed and reasonable basis for the planning, design, construction and operation management of passenger and cargo common railways.

2. Analysis of the Difference between the Main Technical Parameters between the Current Passenger and Freight Common Railway Classification in China

2.1. The Main Technical Parameters of the Current Passenger and Cargo Common Lines I, II, III and IV Railways in China

Railway grade is not only one of the main technical standards for new railways, but also the basis for determining other major technical standards. The division is related to the selection of other technical standards and structural technical standards, such as the technical standards of line level, vertical and cross-section, station distribution, effective length of the departure line and station length.

According to one of the main principles of passenger and cargo common line railway grading: taking into account the design speed of passenger trains in the design line, the railways of 160~200km/h are mainly divided.

According to the existing information, the main technical standards of passenger and cargo common line I, II, III and IV railways can be determined, as shown in the table below.

Table 1. Main technical standard parameters of Class I and Class II railways on passenger and cargo common lines

z		Class I				Class II		
Passenger train design driving speed(km/h)		250	200	160	120	120	100	80
Planar curve radius(m)	Ordinary	4000	3500	2000	1200	1200	800	600
	Difficulty	3500	2800	1600	800	800	600	500
Regular line spacing(m)		4.6	4.4	4.2	4	4	4	4
Limit slope(‰)			Electric power6.0~15.0, Internal combustion6.0~12.0			Electric power 6.0~20.0,Internal combustion 6.0~15.0		
Minimum gradient length (m)		Ordinary 1200,Difficulty 900	Ordinary 600, Difficulty 400	400	The length of the slope should not be less than the value specified in Table 6.4.9 of the Railway Line Design Specification (TB10098-2017, J2399-2017)			
Type of traction		Electric power	Electric power, Internal combustion					
Type of locomotive		Related to the traffic volume, driving speed and traction constant of adjacent lines of the design line, mainly CRH.	It is related to the traffic volume, driving speed and traction of adjacent lines of the designed line.					
Traction quality		Related to the main technical standards of the railway, such as the type of locomotive, the limited slope, and the effective length of the station to the departure line.	It is closely related to the main technical standards of the railway, such as the type of locomotive, the limited slope, and the effective length of the station to the departure line.					
The effective length of the departure line(m)		650	The length of the freight train and the additional distance of the safe parking should be determined according to the transportation needs.					
Design loads		Zk loads	Middle-loads					
Building limits		The provisions of Figure A.0.1 and Figure A.0.3-2 of the Railway Line Design Specification (TB10098-2017, J2399-2017) should be met.	It should comply with the provisions of Figure A.0.2 of the Railway Line Design Specification (TB10098-2017, J2399-2017).		The provisions of Figure A.0.3 of the Railway Line Design Specification (TB10098-2017, J2399-2017) should be met.			

2.2. Differences in the Main Technical Parameters of Current Passenger and Freight Common Railways at All Levels

The design speed of passenger trains corresponding to passenger and freight common railways at all levels is different. The design speed is a comprehensive technical index of the railway. It is an important sign that reflects the level of railway technology equipment, technical standards and operation management, and directly affects engineering investment, transportation costs, economic benefits and transportation quality. The higher the railway level, the higher the passenger train design speed. Among them, the passenger speed of Class I railways is 120 to 200 km/h, and the passenger speeds of Class II, Class III and Class IV railways are 120 km/h and below. The span of Class I railway speeds is very different. Different speed target values correspond to the minimum curve radius, line spacing, minimum slope length, building limit, etc. of the line. To compare and analyze the impact of the technical parameters of each structure with the co-line classification of passenger and cargo, the differences between the main technical parameters at 160km/h, 200km/h and 250km/h are reflected in the minimum curve radius, line spacing, subgrade standards and post-construction settlement requirements of the line, bridge beam type, tunnel clearance, track bed. Thickness, station turnout selection, train operation control mode, disaster prevention and safety monitoring equipment, etc.

2.2.1. Tunnel Technical Parameters

The differences between the technical standards of passenger and freight common railway tunnels at all levels are mainly reflected in the different contour area of the tunnel standard corresponding to different speed target values, the actual section area, the width of the rescue channel surface, and the distance between the rescue channel and the middle line. The main technical parameters selected in different design driving speeds are as follows:

Table 2. Tunnel Technical Parameters

Project			Passenger and cargo common line I-class			
Tunnel	Passenger train design driving speed(km/h)		250	200	160	120
	Standard internal outline(m^2)	Single line	70	58	50	42
		Double line	100	90	80	76
	Actual fault area(m^2)	Single line		60	52-53.6	42.06-44
		Double line	100	92	81.37-87.13	76.63-78.35
	Comfort standard					
	Line distance(m)		5	4.6	4.4	4.2
	Width (rescue channel surface) (m)	Single line			6.6-6.9	5.6-6.3
		Double line	12.6	12.2	11.5	10.6-11.2
	Height (rail surface) (m)	Single line			7.65-8.1	7.1-7.78
		Double line	8.78	8.68	8.15-8.55	8.15-8.5
	The width of the rescue channel(m)		1.5	1.5	1.25	Generally not set
	Distance between the rescue channel and the middle line(m)		2.3	2.3	2.2	
	Effective net space(m^2)		100	80	76	

2.2.2. Track Technical Parameters

Because the passenger and cargo common railway is responsible for the passage of passenger cars with higher running speeds and trucks with larger axle weight at the same time, it has a driving effect on the development of rail diseases. Passenger and cargo common-line railways are higher than passenger special lines in terms of abrasions on rails, dirt on the roadbeds, and the outs of fastener pads. The higher the grade, the larger the weight of the cargo train axle, and the more obvious the power effect is than the EMU, which has a greater impact on the track position and track structure.

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Table 3. Track technology parameter list

Project					Passenger and cargo common line I-class	
Railway	Passenger train design driving speed(km/h)				200	160
	Static smoothness of the track(mm)	Gauge			Stone tablet:±2 No stone tablet:±1	Stone tablet:+4,-2 No stone tablet:±2
		Height			Stone tablet:3/10m No stone tablet:2/10m	4/10m
		Rail direction			Stone tablet:3/10m No stone tablet:2/10m	4/10m
		Level			Stone tablet:3 No stone tablet:1	Stone tablet:4
		Contort			Stone tablet:3 (Base length6.25m)	4(Base length 6.25m)
	Static smoothness of turnout(mm)	Gauge				Sharp rail tip:±1 Others:±3,-2
		Height				4/10m
		Rail direction				4/10m
		Level				4
		Contort				
	Thickness of gravel road bed	Soil roadbed	Double-layer ballad	Surface		30cm
				Bottom layer		20cm
			Single-layer ballad		30cm	30cm
		Hard rock roadbed	Single-layer ballad		35cm	35cm
		Thickness of the bed under the bridge	Thickness of the bed under the bridge		30cm	30cm
	Roadbed state parameters	Horizontal resistance(Kn/Sleeper)			10	10
		Longitudinal resistance(Kn/Sleeper)			12	12
		Support stiffness(Kn/mm)			100	100
		Density(g/cm3)			1.7	1.7
	Railway	Welded joint straightness (mm/m)	Top of the track		+0.3 0	+0.3 0
			The inner working surface of the rail head		+0.3 0	+0.3 0
			Bottom of the track		+0.3 0	+0.5 0
	Grade of railway ballad				First class	First class

2.2.3. Bridge Technical Parameters

The main differences in the technical standard parameters of bridges of passenger and freight common railways of different grades are reflected in the four major aspects of load types, structure (including beam width, tunnel width, etc.), beam deformation control (including vertical deflection, vertical angle of the beam end, etc.), pier deformation control and culvert. The specific differences are shown in the following table:

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Table 4. Bridge technology parameter list

Project				Passenger and cargo common line I-class		
Bridge	Passenger train design driving speed(km/h)			250	200	160
	Load	Train vertical static load		ZK active load	Mid-active load	
	Structure (Double line)	Width of beam body		12.2m	9.36m	9.1m
		Inner net distance of the line center distance contact network pillar		3.0m	2.8m	2.8m
		Width of the trough		9.0m	8.8m	8.6m
		General diagram of simple beams (Span 32m)	Beam height	2.8m	2.7m	2.5m
			Beam weight	Box beam:777t	T beam:146t	T beam:139t
	Beam control	Vertical deflection		L≤40: L/1400 40<L≤80: L/1400 L≥80: L/1000	Span(m) / Single-span / Multi-span L≤20: Single-span L/1000; Multi-span L/1400 20<L≤50: Single-span L/1000; Multi-span L/1200 50<L≤70: Single-span L/9000; Multi-span L/1000 70<L≤96: Single-span L/9000; Multi-span L/900	Continuous concrete beam:Side span L/800,Middle span L/700 Simple steel girder:L/900 Continuous steel beam:Side span L/900,Middle span L/750
		Vertical corner of the beam end		Between beam and bridge:Stone tablet 2‰, No stone tablet 1‰ Between beams:Stone tablet 4‰,No stone tablet 2‰	Between beam and bridge:3‰ Between beams:6‰	
		Beam arches		Stone tablet:20mm No stone tablet:L≤50m, 10mm L>50m, 20mm		
		Horizontal deflection of the beam		1/4000		
	Stage tranny control	Horizontal angle of break caused by lateral horizontal displacement of the pier		1.0‰	1.0‰	Span<40m:1.0‰ Span≥40m:1.0‰
		The deposition of the pier foundation (stational structure)		Uniform settlement: 30mm, 20mm non-ar The difference in the settlement of adjacent piers: 15mm in ballast, 5mm in ballastless	Uniform settlement: 50mm The difference in the settlement of adjacent piers: 20mm	Uniform settlement: 80mm The difference in the settlement of adjacent piers: 40mm
	Culvert	After-dustrial settlement		Same-road subgrade standard	100mm	100mm
	Beam type [universal reference diagram]				[Tongqiao (2016) 2101] or box girder [Tongqiao (2014)2231]	[Tongqiao (2016) 2101]

3. Conclusion

In order to better adapt to the future development trend of China's passenger and cargo common line railway transportation and the sustainability of railway transportation, on the basis of the study of China's current passenger and cargo railway classification standards, according to the development trend of modern railway technology, we seek to build an upgraded version of passenger and cargo common line railway classification standards based on China's national conditions and road conditions, such as Increase grade or segments, add classification technical indicators, etc. In addition, in the process of grading, in addition to considering the original passenger freight volume, line significance and other factors, we should focus on the impact of speed on the classification of passenger and cargo common line railways, further explore China's passenger and cargo common line railway classification standards, and provide a more detailed and reasonable basis for the planning, design, construction and operation management of passenger and cargo common railways.

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