Academic Journal of Science and Technology
ISSN: 2771-3032 | Vol. 7, No. 1, 2023

Analysis of Drainage Points on Red Tourist Road of Li Dazhao's Former Residence

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Abstract: This article is located in the Tangshan Leting County second-class Highway. The total length of the designed road is about 3514 meters and the designed speed is 60 km/h. Vertical section design is to design vertical slope and vertical curve, and calculate the vertical curve elements, pay attention to the combination of horizontal and vertical design; Cross-section design is to determine the shape of cross-section, carry out super-high design and calculate earth-rock work under the condition of considering many factors. This paper analyzes the method of constant gradient arch in cross section and longitudinal section and the method of rotation around the edge of central divider, and mainly analyzes the positive significance of using these two methods to pavement drainage, as well as the impact on the road vehicle operation.

Keywords: Longitudinal section design, Vertical curve element calculation, Longitudinal linear longitudinal slope.

1. Longitudinal Slope Design Requirements

Road cross-section design refers to the horizontal design elements in the road layout, including the road geometry, lane width, sidewalk, bike path, central barrier, etc. . The significance of road cross-section design is to provide a safe, efficient and comfortable traffic environment, improve road accessibility, and enhance the city image. Reasonable cross-section design is an important part of building a modern and sustainable city. The longitudinal section design of the road refers to the longitudinal design elements in the road layout, including the longitudinal slope of the road, super-high and longitudinal curve. The significance of road profile design is to provide a safe, efficient and comfortable traffic environment, to ensure the smooth passage of the road, improve traffic efficiency and quality of life. The rational design of longitudinal section has an important influence on the function of road, the smooth progress of transportation and the sustainable development of city. This article is about the design of the cross-section of the red tourist road construction in Li Dazhao's former residence, including the design of vertical slope, vertical curve, cross-section and extra-high widening, according to the specific geographical location of the road and the status quo of the factors, calculated in line with the safety, traffic efficiency, comfort of the cross-sectional design data. At the same time, the main points of drainage design in cross-sectional design are analyzed.

2. Longitudinal Slope Design

2.1. Longitudinal slope design requirements

The design of longitudinal slope must meet the requirements of highway engineering technical standards, should make the longitudinal slope have a certain degree of smoothness, which is to enable the car to drive safely and steadily on the road, try to avoid too large or too frequent longitudinal slope, in order to ensure the smooth and stable of the highway, the limit value of longitudinal slope should be avoided as far as possible, and the natural conditions such as topography, geology, water temperature and climate should be considered synthetically in the design of longitudinal slope In order to ensure the stability of the roadbed, the road sections in the plain, hilly area and wet area with high groundwater level need to meet the requirements of the minimum filling height, and the longitudinal slope should be designed to ensure the balance of filling and excavation as far as possible, use the nearest section as a source of excavation, reducing debits and scrap, reducing unnecessary costs.

2.2. The steps of longitudinal slope design

According to the above principles and requirements, the longitudinal slope design should follow the following steps: before the formal design, we should read the relevant documents carefully and master the design intention. Mark out the control points. Trial Slope: according to the control point, determine the slope line. This design is the use of the latitude design program in the automatic fitting function to fit the slope line. Adjustment: the proposed slope and the slope previously considered as much as possible to achieve consistency. Check: the main check has an important control point section. Determine the longitudinal slope: from the beginning to the end of the slope line to determine the value of different degrees of slope, change the position of slope and elevation.

2.3. Determination of longitudinal slope design index

If the car driving a long steep slope, the uphill need to drive in low gear for a long time, the need for frequent downhill braking, driving safety problems may be caused. Therefore, the maximum slope length must be limited. According to“Highway route design code”(JTG D20 -2017) , the maximum slope length corresponding to different vehicle speeds is shown in table 3.1, and the values in this design are in accordance with the requirements.

Table 1. Maximum slope lengths for different longitudinal slopes

Design speed (km/h)		120	100	80	60
Vertical slope gradient (%)	3	900	1000	1100	1200
	4	700	800	900	1000
	5	-	600	700	800
	6	-	-	500	600
	7	-	-	-	-
	8	-	-	-	-
	9	-	-	-	-
	10	-	-	-	-

3. Vertical Curve Design

3.1. The minimum length of a vertical curve

The length of vertical curve can not be too short, otherwise it will make the driver have a feeling that the slope changes very quickly. According to the specification, the minimum length of vertical curve is calculated by 3s travel time.

Table 2. Vertical curve indicator table

number	Stake number	Elevation	Radius of vertical curve	Front longitudinal slope (%)	Rear longitudinal slope (%)	The length of a vertical curve	Type of vertical curve
1	K0+240.0	7.178	10000	0.8	-0.82	162	Convex
2	K0+580.0	4.39	10000	-0.82	0.57	139	Convex
3	K0+960.0	6.556	13000	0.57	-0.74	170.3	Convex
4	K1+470.0	2.782	13000	-0.74	0.58	171.6	Concave
5	K2+030.0	6.03	15000	0.58	-0.51	163.5	Convex
6	K2+460.0	3.837	15000	-0.51	0.62	169.5	Concave
7	K2+740.0	5.573	10000	0.62	-0.52	114	Convex
8	K3+080.0	3.805	15000	-0.52	0.656	176.608	Concave

$$L_{\min} = \frac{V}{1.2} = \frac{60}{1.2} = 50(m)$$

Table 3. Vertical curve length table

Serial number	Change the slope point pile number	Length(m)
1	K0+240.000	162
2	K0+580.000	139
3	K0+960.00	170.3
4	K1+470.000	171.6
5	K2+030.000	163.5
6	K2+460.000	169.5
7	K2+740.000	114
8	K3+080.000	176.608

3.2. Vertical curve element calculation

Slope angle: $\omega = i_2 - i_1$ (1)

The length of the curve: $L = R\omega$ (2)

A vertical curve has a long tangent: $T = \frac{L}{2} = \frac{R\omega}{2}$ (3)

Outer distance of vertical curve: $E = \frac{T^2}{2R}$ (4)

Pile number: K0 240; Elevation: 7.178m; R=10000m; $i_1 = +0.8\%$; $i_2 = -0.82\%$

$$\omega = i_2 - i_1 = -0.82 - 0.8\% = -1.62\% < 0, \text{Convex}$$

$$L = R\omega = 10000 \times 1.62\% = 162(\text{m})$$

$$T = \frac{L}{2} = \frac{162}{2} = 81(m)$$

$$E = \frac{T^2}{2R} = \frac{81^2}{2 \times 10000} = 0.328(m)$$

3.3. Situations should be avoided in the design

The range of horizontal curve should include the range check of vertical curve, the starting and ending point of vertical curve should be in the range of horizontal curve, and the starting and ending point of horizontal curve should not be in the range of vertical curve. A horizontal curve should not contain more than one vertical curve, and should contain only one vertical curve within the range of a horizontal curve. A vertical curve should not contain more than one horizontal curve. A vertical curve should contain only one horizontal curve within its range.

4. Analysis of Main Points of Road Cross-section Drainage Design

4.1. Analysis of key points of constant slope of cross-section road arch

The constant slope design of cross-section road arch is very important for pavement drainage, which needs to consider the slope direction, gradient, transverse slope, cross-section shape and reasonable drainage facilities. A properly designed slope and drainage system can ensure smooth drainage of the road surface, reducing the risk of water accumulation and water damage. According to the geographic location information and environmental factors of the road studied, and considering the requirements of the design code of"Highway route design code"(JTG D20-2017) , the constant slope of road arch is increased by 2% in this design, to achieve safety, drainage, comfort, visual beauty and engineering feasibility and other points. Improve the road performance and comfort, for the vehicle running to provide good conditions.

4.2. Vertical curve element calculation

The central divider edge rotation method is a common drainage method used in the design of expressways and expressways. It improves the drainage performance of the pavement by setting a rotating pavement cross-section at the edge of the central divider. The central divider edge rotation method has a positive impact on pavement drainage, including improving drainage capacity, reducing the risk of water accumulation and reducing pavement damage. It is a common drainage method, especially suitable for highway and expressway road design which needs higher drainage performance.

5. Conclusion

1. This design increases the road arch constant gradient 2% design, enhances the road surface transverse drainage ability.

2. Adopting the method of rotating around the edge of the central divider, by adjusting the shape and slope of the roadbed, the drainage efficiency of the road surface can be maximally improved, and the formation of water and mud can be reduced, to ensure that the road in the rain to keep dry, can avoid or reduce the water on the pavement structure of the adverse effects, extend the service life of the pavement

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