

The Key Technical Factors Analysis of Road Reconstruction and Design

Nianchuan QIAN

Institute of Civil Engineering, Chongqing Jiaotong University, 40074, Chongqing, CHINA

Abstract: The reconstruction of highway engineering is complex system engineering. This article puts forward the main points of design about the route of highway reconstruction overall design and linear route design, roadbed engineering, road engineering, on the basis of investigating and evaluating the existing road in detail, and explained, which provided reference for highway reconstruction theory basis.

Keywords: Road; Reconstruction; Design points

1. Introduction

With the development of society and economy, China's network of lower levels of roads and already achieved or will achieve the design life of the road surface occupies a large proportion. Due to the extended use and maintenance funds shortage, this part of the road driving conditions becomes more bad, which impact on the smooth road and transportation efficiency directly. Both its bearing capacity and its adaptability to the current transport are ragged, leading to affect the economy along the road, the development of the society seriously. So it is very necessary to upgrade the road. And it is also an essential means of improving the usability of road to create more economic benefit and social benefit by coordinating the existing road network effectively. It's totally different between the road reconstruction design and new road design. The road reconstruction design pays more attention to "change", expanding", aiming at upgrading linear and improving the standard in the use of the original road linear and subgrade, which could reduce the quantities, investment and enhance the usability of road.

2. Route Design Points

Route design includes highway overall design and linear route design. Route design is closely related to and linear and restraining each other.

When choose the trend of highway routes, we should be reasonable use of topography, technology standards correctly to ensure the linear balance. and properly handled in the design of the forward and recent, the relationship between the whole and local, then combined with the natural conditions, such as topography, geology, hydrology, meteorology, road materials, what's more, give full consideration to agriculture and environmental protection requirements, pay attention to cooperation and coordination of railways, shipping, air transport and pipeline transport. Different schemes of the project cost and im-

pact on the natural and social environment should be sufficient demonstration and analysis, to achieve the unification of the technical and economic and environmental benefit.

Route design of reorganization and expansion should be flat, vertical and horizontal to keep the coordinated between each element. The higher the Highway rebuilding grade is, the more prominent the role of coordinate combination designs. Flat, vertical and horizontal combination is not only to meet the requirements of automobile dynamic performance, but also to meet the requirements of drivers' visual and psychological aspects. This is extremely important to ensure the safety of the car comfortable. As combine inappropriate linear combine, it's easy to cause traffic accidents, reduce the traffic capacity.

2.1. Route overall design points

According to the characters of terrain, determine the type of terrain and computation speed;

Line up and the end must make the route scheme and recent specific design within the scope of a certain length, except the conforming to the requirements of the road network planning necessarily.

Reasonable delimit the reconstruction design route length, choose different design sections of cohesion right place, and handle connecting linear design within the scope of a certain length before and after the set;

Determine the lane number according to the traffic flow and operation needs;

Survey along the main town planning, and determine the way they are connected to, and the location

Survey along the traffic, social, natural conditions, and then determine the interoperable stereoscopic cross location and its connection way;

According to the function of the product, determine the traffic safety facilities, traffic management facilities, and parking area, service area, layout and location;

For toll roads shall be determined on the basis of the argument way to charge; consider the position and spacing of interoperable interchange, service area, parking area, bus stops, the position large bridges, tunnels to ensure the minimum distance of traffic safety need; Planning the installment construction project, must make the design of the phased implementation on the basis of technical standards of design.

2.2. Linear design points

To meets the demand of the car mechanics, make the car on the highway driving stability, comfort, economy, therefore, the construction process should pay attention to using the corresponding specification design index, pay a attention to the continuity between the linear, avoid linear mutation.

To meet the requirements of the driver's visual and psychological, balance between linear elements and other facilities coordination. It's important to be in harmony with the terrain and environment. It's asked to combine with optimization design to along the route, especially combined with the terrain, terrain conditions, using all kinds of linear elements. Not one-sided emphasis is given priority to with straight line or curve, but also should pay attention to the linear and the environment coordination in the design, which make the natural landscape of road construction is not damage the environment, and protect the environment, reduce the interference to the environment, and try to use the environment, change environment, and to be coordination, harmony, the massing. Along with the resources of land use, resource development and the social economic conditions, should be paid attention to less of farmland, reduce demolition of quantities.

3. The Flat, Vertical, Horizontal Design Points

3.1. Linear design plan points

Direct, continuous and balanced linear adapt to the terrain perfectly, and is in harmony with the surrounding environment. The selection of Straight line, round curve, swing line and reasonable combination depends on specific conditions terrain. it is unwise that one-sided emphasis on route to give priority to with straight line or curve or think the proportion among of them.

Kinds of road, both corner size shall be equipped curve, and try to choose a larger radius of circular curve. Between two synthetic curves should be sufficiently long line, have short straight line connection, otherwise should be adjusted into a single linear curve or complex curve or using cyclotron quad synthetic ovate, convex model, the complex curve. Sandwiched between two reverse curves with straight line set up no less than the minimum line

length of line segment advisable, otherwise should be adjusted or using cyclotron lines and s-shaped curve. Curve linear should pay special attention to the technical index of equilibrium and continuity, avoid sharp line in succession. For dealing with this, we can insert a straight line or cyclotron lines long enough between the curves.

3.2. Profile linear design key points

Highway reconstruction profile design is to deal with the relationship of profile bright line. The one is the original road design line; another line is the road reconstruction design. Profile of the linear change should be adapted to the original road and terrain conditions, designed to visual continuous, smooth and slick line to eliminate the longitudinal slope of the ups and downs frequently seen in short distance; Should avoid and eliminate the intelligent saw nearby and distant, but can't see the concave in the middle of the profile line; At the long continuous uphill section, should be the steepest of longitudinal slope on the bottom of the slope section, at the close to the top grade appropriate is slowing down; Adjacent longitudinal slope of the algebraic difference hours, should try to use large radius of vertical curve;

Longitudinal slope should be smooth before and after the intersections;

In snow or ice area, should avoid using steep slope;

3.3. The combination of flat, vertical linear design points

The combination of flat, vertical linear design is the last stage of the geometric design. If the flat, vertical alignment is in a good coordination, it helps to play to their respective advantages without increasing the cost but can enhance the effect of road. And helps keep the car driving at a constant speed and traffic safety and beautiful road capacity.

The combination of flat, vertical linear design should pay attention to the following:

Can guide the driver's line of sight, naturally and maintain visual continuity on the vision. Pay attention to keep the technical indicators in a equilibrium size between the flat and vertical. Coordinate the line of sight on the vision and psychological. Limit of low profile using standard grade or the minimum radius of vertical curve used in the plane but with high linear is meaningless, and vice versa. Choose combination proper synthetic slope section for pavement drainage and driving safety. Noting road environment, it can reduce the driver's fatigue and tension, and can play a guiding role. Vertical curve of end respectively on plane curve and two best easement curve, in which righteousness is not in line outside the easement curve, also do not put in the arc segment, if flat, vertical curve radius is large, flat, vertical position is not restricted by the above; If can't do, good combination of vertical curve, it should be both away quite a distance,

the plane curve in the straight slope is located in a straight line segments or vertical curve[1].

3.4. Cross-sectional design points

Highway cross section is composed of cross-sectional design line and ground line. Cross-sectional design line includes the driveway, shoulder, separation zone, ditches, slope, water drainage ditches, and banquette and borrow pit, spoil bank, environmental protection facilities. Reconstruction road cross-section design and size of each part should be determined by the design traffic volume, traffic composition, design speed and topographic factors. Cross-sectional reconstruction design attribute points as follows:

It is necessary to study the relations between all kinds of vehicles and road facilities of spatial in the road cross-sectional reconstruction. To be sure the scope of land for roads Reasonably, it refers to the reconstruction of highway embankment on both sides of the drain outside edge (toe) or cutting slope intercepting ditch outside edge (or top) is not less than 1 m, express ways, first class roads in a conditional location is not less than 3 m, secondary roads not less than 2 m. Determine the standard cross section, in the standard cross-sections, typically contains the embankment, cutting and half filling and half digging, shoulder subgrade retaining wall embankment and subgrade, such as masonry section of the slope rate, the size of the ditches, such as retaining wall section according to the existing roadbed design norms argument, if there are any high fill and deep excavation, flooding of subgrade and soft soil should be separately designed.

4. The Design of Highway Subgrade Engineering Reconstruction

Highway roadbed engineering construction and design roadbed is one of the main structures of highway and the bearing layer. The strength and stability is to guarantee stability of pavement structure, the basic conditions for good performance of road use.

4.1. The reconstruction design of highway subgrade engineering

To ensure the shoulder width, allowing temporary failure, and accident vehicle parked, usually for 3 m (including side strip and the hard shoulder), plus a protective shoulder is 0.5 m. Special area (including Bridges, highways, tunnels, etc.) can use the width of the 2 m only considered the temporary parking department, that means 0.75 m side strip, the hard shoulder 1.25 m [2].

4.2. The slope design points

Subgrade slope include cutting slope and embankment slope. Slope grade is very important for the slope stability and the stability of the roadbed overall. It is a important premise to ensure the subgrade slope for a reasonable

angle. The size of the slope depends on the nature of the slope soil, rock and hydro geological conditions and other natural factors and the height of the slope. The influencing factors of embankment slope are: packing type, slope height, and type of embankment. And the influencing factors of cut slope stability is relatively complex, in addition to cutting depth and the nature of the slope rock body, geological tectonic characteristics, the degree of rock weathering and broken, the layer of genetic types, surface water and groundwater, and the facing and the local climate conditions and so on. All of them can affect the stability of cutting slope. Soil cut slope should consider the slope height, dense degree of soil, groundwater and surface water, soil causes and formation age and other factors.

4.3. Subgrade drainage points

Subgrade drainage facility is divided into surface drainage and underground drainage facilities. Subgrade drainage should be comprehensive planning, rational layout, accounts for less farmland, and coordinate with the local irrigation and drainage, prevent destroyed farmland and water conservancy facilities; Attaches great importance to environmental protection, prevent soil erosion and water pollution. According to road grade, it should be comprehensive considered that along the condition such as topography, geology, hydrology, meteorology and bridge culvert settings, and so on. Pay attention to the connection between the various drainage, drainage works to make the full form perfect drainage system. Constantly on the basis of summarizing the practical experience of engineering, we should use the active new materials, new technology and new technology. Considering the construction site temporary drainage facilities, and combine the permanent drainage facilities as far as possible. The design of drainage facilities and installations shall be considered to facilitate the construction, inspection and maintenance. Highway through town, the drainage design should be coordinated with drainage of the town planning and facilities. Loess, expansive soil, saline soil, permafrost, landslides, and other special areas of highway, the drainage design should be comprehensive integrated the other disposal measures of the engineering.

4.4. The design points of roadbed protection and retaining structure

Subgrade protection and reinforcement project can be divided into broken surface protection, scour protection three types of retaining structures according to their different role. Specific design key points can be combined with the existing protection and design of retaining structure in accordance with the new regulations.

5. The Road Engineering Design Points

5.1. The reconstruction design of existing highway asphalt pavement

When the road surface to be rebuilt for asphalt pavement, before the reconstruction of roads should be paid attention to the following two points: analyzing the existing situation of asphalt pavement to provide a basis and countermeasures of large, long road renewal project. Longer to be renovated road route, should cope with partitioning across the road to each sections designed to provide an appropriate reconstruction programmed. The survey data have been obtained on the basis of evaluate the damage status of asphalt pavement, the pavement quality, based on the principles of centesimal system is divided into excellent, good, poor, time, in the five grades, for each grade of the evaluation criteria and corresponding differential range and corresponding maintenance strategy type.

1) The design of existing highway asphalt pavement widening

The road widening includes the unilateral and bilateral widened. Double side widening, should widen equal on both sides of the way. When the road surface can't be widened equally on both sides, we don't need to adjust

the cross slope as the widening difference in 1 m. If widened more than 1 m on both sides, must adjust road arch transverse slope. Due to the limitation to linear and terrain conditions, widen the side need to set the arch triangle cushion layer adopting unilateral widened. Adjusting arch triangle cushion should satisfy certain thickness according to the requirement of the materials used, lest in widening the surface and form thin gap between the old coat, and at the same time pay attention to the triangle connection of cushion and pavement structure layer. Determination of paving layer thickness may refer to the corresponding specification, but note that when using standard calculation method for asphalt layer more than 15 cm is, in general it is not economic, and easy to produce the rutting disease. Considering in pavement add certain thickness of semi-rigid base, in order to improve the pavement structural strength, thus reduce the thickness of asphalt layer, at the same time, the minimum thickness of asphalt layer also should not be less than 5 cm. Adding layer structure design should be based on the use of the existing pavement performance tuning and evaluation results, using Table 1 the overlay structure types [3].

Table 1. Asphalt pavement structure layer recommendation form

Number	Structure of overlay	The original asphalt pavement condition evaluation			
		PCI	SSI	RQI	BPN
1	5cmSMA+ Geotextiles sandwich	fair	good	Poor, bad	Poor, bad
2	4cmSMA+5 6cmMedium grained asphalt concrete+ Geotextiles sandwich	Fair, poor	fair	-	-
3	4cmSMA+5 6cmMedium grained asphalt concrete+ Geotextiles sandwich +8 cmCoarse grained asphalt concrete+ Geo grid sandwich	Poor, bad	poor	-	-
4	4cmSMA+5 6cmMedium grained asphalt concrete+ Geotextiles sandwich +8 cmCoarse grained asphalt concrete+20 40cmTwo ash crushed stone	bad	bad	-	-
5	4cmSMA+5 6cmMedium grained asphalt concrete+ Geotextiles sandwich +8 cmCoarse grained asphalt concrete+20 40cmCement stabilized crushed stone	bad	bad	-	-

5.2 The reconstruction design of existing road cement concrete pavement

In the use process of cement concrete pavement, its performance will gradually decay due to the traffic load and environmental factors. When the condition of pavement structure or surface function cannot satisfy the use requirement, repair measures are needed to restore or improve the performance of its use. It is a full use of the old road surface residual strength by lying of paving layer in the existing cement concrete pavement, which can recover or improve the technical measures in a long period of time.

1) The key points of design widening concrete pavement

On roadbed widening, the slope will be removed weeds, roots, and lose material, and should be layered filling compaction soil base; must deal with new and old roadbed of cohesion. Roadbed and basic interface should

lay a layer of geo grid in the junction of new and old roadbed; When widen roadbed, subgrade drainage system should be well.

In pavement base, widen new widened the grass-roots strength shall not be lower than the original strength on the base of the cement concrete road surface, and can be used to fault overlap method.

Widening concrete road on both sides can be directly widened, as the original roadbed is wide, and the road widened posterior shoulder width is greater than 75 cm; for roadbed narrower less of widening the road pavement conditions, should be widening subgrade. If the construction machinery and operation method can guarantee the roadbed widening part reaches the compactness, can widen the road, otherwise should be widening after being stable roadbed compaction. Double side widening should adopt the way of equal on both sides of the widening.

When concrete pavement unilateral widened should set up top high, widening according to the technical standard in a flat curve. if not, should also be combined with widening set.

2) *Overlay structure design*

Overlay design on the existing cement concrete pavement of cement concrete paving can be used separate or combined type cement concrete overlay structure, and compare with the technical and economic according to the requirement and the condition of the old pavement.

Separate layer structure design should be setting isolation layer in the old concrete paving layer. Isolation layer can choose asphalt concrete, asphalt sand or linoleum, etc. Among them, the thickness of asphalt concrete isolation layer should not be less than 25 mm; The form and position of separate concrete paving layer seam can decorate according to the requirement of the new concrete pavement and don't need correspond to old concrete pavement joint.

Combination type concrete paving layer structure design, the minimum thickness of 25 mm, on the one hand, measures should be taken to thoroughly clean the dirt on the surface of the old concrete pavement and cement mortar, on the other hand, need to smear epoxy resin emulsion and high strength of the adhesive after cleaned the surface before paving to paving layer and the old concrete pavement binding knot a whole; The form and

position of overlay seam must be aligned with the old concrete pavement completely.

6. Conclusion

Highway reconstruction is complicated system engineering. This article only from the view of design point considers the main design points of road rehabilitation and expansion. The purpose is that improve the various parameters to improve the original road toward a higher standard, recovery performance. Generalization of highway construction should be "adjust measures to local conditions". According to the environment along the line, adopt high technology in the technical conditions and economic conditions permit. In this paper, for the limited space, cement concrete pavement reconstruction is not noted in detail in this paper, but there are a lot of similarities between asphalt pavement and cement concrete pavement reconstruction.

References

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