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Research on the Taishan road reconstruction Project in Zhangzhou Development Zone

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Abstract. Road Reconstruction Project of Taishan Road (Zhaoshang Avenue-Zhujiang Road) in China Merchants Zhangzhou Economic and Technological Development Zone has the characteristics of the dense residents, large pedestrian volume, lots of intersections, many underground pipelines, and small construction working surface etc. Aiming at these complex construction conditions, specific requirements for padding in subgrade construction, methods for pit excavation and slope protection, and the retaining way of cantilever retaining wall used for adjacent buildings were introduced. Maintenance plan was given for solving quality problems in old concrete pavement; problems generated in connection of new and old roads were solved; barrier-free design method of section was proposed, which guaranteed smooth implementation of the project and provided a good example for similar project construction method.

1. Project overview

Taishan Road (Zhaoshang Avenue-Zhujiang Road) Reconstruction Project in Zhangzhou Development Zone is located in China Merchants Zhangzhou Economic and Technological Development Zone. The starting point (stake No.: K0+000) of the project is connected with Zhaoshang Road; the end point is at Zhujiang Road (K0+797.474). Moreover, overall length of the road is 797.47m, which is shown in Fig. 1. The route is arranged along the old road corridor in the south. Intersection between Zhaoshang Road and the Project, storefront along the route, traffic police brigade, fire brigade of public security, and existing road are arranged as control factors.

Fig. 1 Diagram of the road location

Road grade is urban branch road with two-way four lanes. Calculated running speed is 30km/h with road width ranging from 21.25m to 22.5m. Motorway is bituminous concrete pavement with design working life of 10 years. Road width of road cross-section from 0m to 440m is 22.5m, while that of road cross-section from 440m to 797.47m is 21.25m.

There is a discarded cable trench under existing sidewalk of the Project. A new cable trench is constructed 1m away from the road sideline. Water supply pipeline is not moved. As earth covering does not satisfy requirements, protection for pavement structure is required to be strengthened so as to avoid rolling damage. Current gas pipeline is required to be discarded and shall be reconstructed in central green belt. Current sewage pipeline is required to be discarded. A new sewage pipeline with diameter of 500mm shall be embedded under the motorway on the east side. Current street lamp cable is required to be moved, which shall be set under the sidewalk on the west side of design road. Road lighting is subject to bilateral symmetry arrangement. LED double-arm street lamp is used for lighting.

Intersection between the starting point of the Project and Zhaoshang Avenue has been completely constructed. Moreover, bituminous pavement is extended to scope of the Project. 5m of current bituminous pavement in the intersection between construction starting point and Zhaoshang Avenue in the Project is broken so as to be connected with new overlay pavement.Cement concrete pavement is good along the road, which can be directly used as subgrade of the reconstruction. In terms of section which is required to be widened, the same structure as that of current cement concrete shall be used. Surface is uniformly paved with bituminous concrete. Current sidewalk is paved with chaotic materials. Water permeable brick is uniformly used for pavement in the reconstruction.

Although the section is not long, it is located in the residential quarter with dense residents, large pedestrian volume, and lots of surrounding canteen storefronts on both sides. The old road is concrete pavement; most of the section is excavation subgrade. Subgrade in pavement widening, technical treatment of pavement, treatment of old cement concrete pavement, and pipeline arrangement problems shall be noted in reconstruction process. Moreover, traffic conditions shall be comprehensively considered. Construction shall be reasonably arranged.

2. Reconstruction of subgrade engineering

The Project belongs to old road reconstruction, which mainly aims at treatment for widened carriageway and sidewalk. Specific treatment methods are as follows: (1)Excavation subgrade, Excavation slope on both side of the road is not high in the Project. The gradient of 1:0.75～1:1 is used for excavation according to actual conditions.

(2) Subgrade slope protection, Gap between sidewalk edge and surrounding building is designed to be between 1.08m and 1.36m on the west side of section K0+463.580～K0+774.823. Designed elevation difference between building and road on the section is between 0.14m and 1.07m. Therefore, C30 reinforced concrete retaining wall is considered to be used for retaining on the section so as to avoid building demolition .

Inverted layer is set within 50m on the back of the retaining wall; sand gravel and other permeable materials with coarse particle are selected in inverted layer. In order to prevent the retaining wall from being damaged caused by crack due to differential settlement or temperature change of subgrade, settlement joint and expansion joint are required to be set with width ranging from 2m to 3m. In addition, bitumen, oakum, and other joint sealing materials are required to be filled in the joint [1].

(3) Pit excavation, Temporary drainage measures on site shall be taken before excavation. Ponding in the pit on a rainy day shall be drained at any time. Excavation by pits shall be conducted so as to avoid foundation pit collapse.All soil foundation pits shall not be exposed, disturbed, or soaked for a long time after being excavated to elevation so as to avoid weakening bearing capacity of foundation base. 10cm to 20cm of thickness shall be kept for soil foundation pit after it is excavated to approach elevation. Excavation shall be checked before construction of foundation [2,3].

3. Reconstruction of pavement engineering

3.1 Widening treatment of pavement

There may be settlement problems due to reconstruction of expanded subgrade. How to guarantee that there is no longitudinal crack between original pavement overlay and newly constructed section is the problem which shall be solved for key technology research on pavement.

In case subgrade width is insufficient at the time of widening cement concrete pavement, subgrade shall be widened so as to avoid settlement of pavement slab caused by compression subsidence of new subgrade. Elevation of new subgrade shall be a little lower than that of old subgrade on the same cross section. Cross slope of new and old subgrade shall be identical so as to guarantee drainage of pavement base.

In case pavement base is required to be widened, in addition to comprehensive survey for original pavement, widened structure strength shall be equal to that of original pavement base. Moreover, old structure shall be reasonably used; good materials shall be selected so as to make combinational design in combination with utilization of original pavement base materials [4].

As an earth fill with width ranging from 20cm to 30cm at the joint of new and old subgrade cannot be rolled by large-scale road roller, there may be longitudinal crack at the joint of new and old pavement under contraction effect of newly constructed cement stability materials and comprehensive effect including a large number of vehicle vibration influence, and other factors on the old road [5]. Used method is to conduct construction in two stages on the pavement. Firstly, new and old pavement shall be connected. Crack shall be repaired and thoroughly treated after the old pavement is recapped.

3.2 Problem solving of old cement concrete plate

There are lots of damages and existing quality problems on old cement concrete pavement in use process and height difference of new pavement in connection process, such as crack, excessively high pavement or settlement, joint maintenance, and etc. Design and treatment scheme is proposed for these problems.

(1) Crack treatment, 1) Joint with width of less than 1cm shall be cleaned with crack-cleaning machine and shall be subjected to pouring with epoxy mortar. Joint wall shall be vertical at the time of cleaning. In case joint width is less than 0.5cm, width of expansion joint shall be between 0.6cm and 1cm with depth ranging from 2.5cm and 3cm. Then, epoxy mortar shall be used for pouring. In case joint width is more than 0.5cm, epoxy mortar shall be directly used for pouring treatment after cleaning. 2) In case joint width is more than 1cm and less than 1.5cm, there is no boiling at the joint, flexure is no less than 20 (0.01mm), it indicates that the foundation is good. Sundries in the joint shall be removed; depth shall be no more than 5cm; epoxy mortar shall be used for pouring.3) In case the joint width is more than 1.5cm, total depth patch processing shall be used.

(2) Excessive height of original pavement, Original pavement of certain section is higher than elevation of design pavement, which cannot satisfy the requirement for the minimum overlay thickness (11cm). In case 5cm $\leqslant$ designed elevation-current elevation < 11cm, the pavement shall be firstly milled; then, asphalt overlay shall be conducted; in case designed elevation-current elevation < 5cm, original cement slab shall be excavated. 5% of cement stabilized macadam and new cement concrete slab shall be paved after thickness of asphalt overlay is deducted.

(3) Joint maintenance, In case there is crack on the joint, maintenance methods are as follows: a regular graph shall be incised on the edge of broken part; surrounding facet shall be vertical to panel; the bottom shall be plane; broken concrete shall be eliminated; duet and sundries shall be cleaned; dry condition shall be maintained. Reinforced material with high modulus shall be used for filling and maintenance. Technical performance of materials shall conform to standard requirements [6].

4. Barrier-free design

Trip of the disabled and senior people is mainly considered in barrier-free design. Relevant road traffic equipment is set on the sidewalk, intersection, and etc. The following measures are considered being taken so as to make barrier-free design according to GB50763—2012 *Barrier-Free Design Code.*

4.1 Barrier-free design of section

Blind sidewalk shall be paved on road section so as to guide the blind to walk according to touch on foot. A warning blind sidewalk shall be set in the turning point of the blind sidewalk. Warning blind sideway shall be used to warn the blind to avoid actual barrier or possible danger, which is shown in Fig.2. Sidewalk shall be flat road without height difference so that the disabled can move with wheelchair. In case there is height difference or horizontal pit, it will be difficult for the disabled to move on it. Curb ramp shall be set for wheelchair.

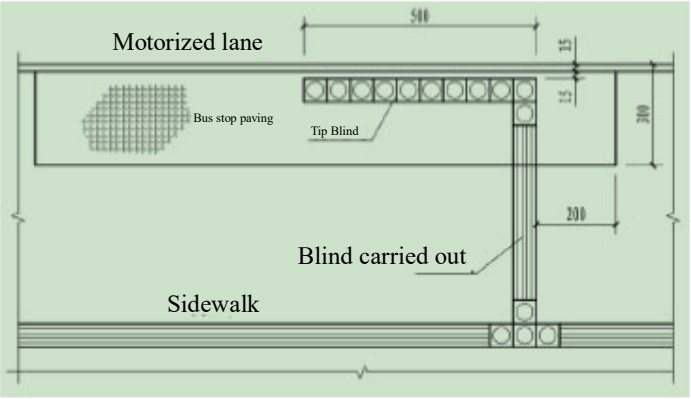

Fig. 2 Arrangement diagram of Crossed Warning Blind Sidewalk

4.2 Barrier-free design of intersection

Curb ramp shall be set in the position of curb on corresponding pedestrian crosswalk to sidewalk at road intersection. Ramp slope shall be flat and anti-skid. Pedestrian crosswalk in the intersection shall pass across both sides of the road. Height shall be lower after road and isolation strip so that wheelchair can move. Arrangement method of warning blind sidewalk in the intersection shall be T-shaped, L-shaped, and crossed so that the disabled can smoothly pass across the intersection.

5. Summary

Road Reconstruction Project of Taishan Road in Zhangzhou Development Zone has the characteristics of the dense community residents on both sides of the road, large pedestrian volume, lots of intersections. Current drainage pipeline, electric power and communication pipeline are complex. This paper introduces the processing method of the quality problems of old concrete pavement, the main technical measures of subgrade and pavement widening process, proposes the barrier-free design method of section. It provides the basis for the reasonable arrangement with transportation and construction, reduces the construction risk, ensures the smooth progress of the project.

References

[1] Xu Jianqing, The Earthquake Analysis of Cantilever Retaining Wall Under the Soil-Structure Interaction, Zhejiang Construction, vol.33, pp. 18-23, 2016.

[2] Cheng Zhi-yong, Yang Chun-shan, Lv Zhi-gang, Study on Impact of foundation Excavation on Environment Based on space effect, Architecture Technology, vol.46, pp. 491-494, 2015.

[3] Li Xiangqun, Zhang Zhaohui, Sutdy on Influence of Pipeline Dispalcement Caused by Foundation Pit Excavation, Geotechnical Engineering Technique, vol.31, pp. 253-257, 2010.

[4] Luo Bo. Study on The Key Technology For Subgrade and Pavement Widening of Expressway [D]. Xi'an: Chang'an University, 2010.

[5] Guo tao. Freeway Rebuilding plan selection and pavement recycling Standards[D]. Xi'an: Chang'an University, 2013.

[6] Zeng Sheng, Zeng Qingxia, Improveent on the Cement Pavemen tPerformance Evaluation Index System of the Comprehensive which Based on Fuzzy Mathematics, Highway Engineering, vol. 33, pp. 47-51, 2008.