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Research on Construction Technology of Ballastless Track

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Abstract

Through the analysis of relevant data and the related knowledge taught by teachers, it can be seen that the application of ballastless track construction technology in high-speed railway industry at this stage promotes the development of high-speed railway industry in China, and the construction quality of ballastless track plays a very important role in ensuring the safe and smooth operation of high-speed railway. In this paper, the technical characteristics of ballastless track, types of ballastless track, technical difficulties of ballastless track construction and effective measures of ballastless track construction technology control are studied. It is considered that the construction unit should attach great importance to the construction technology of ballastless track, accurately grasp the difficult problems in the construction technology, continuously summarize the construction experience, improve and innovate the existing construction technology, and comprehensively improve the construction quality and efficiency of ballastless track, so as to provide more reliable technical guarantee for the development of China's high-speed railway and promote the modernization of high-speed railway. This paper discusses the construction technology of ballastless track, hoping to arouse people's attention and solve the problems of relevant personnel.

Keywords

Ballastless track; Technical characteristics; Track type; Construction technical difficulties; Effective measures.

1. Technical Characteristics of Ballastless Track

1.1. Good Structural Continuity and Smoothness

The ballast track adopts natural ballast material with poor homogeneity. Under the action of train load, the width of ballast shoulder, the height of ballast shoulder, the side slope of ballast bed, the gauge spacing and the supporting state of sleeper in the track bed are relatively easy to change, which leads to the track geometric deformation. The lower foundation, base, track bed slab or mortar adjustment layer of ballastless track are all cast in-situ industrialization. Double block sleepers, track slabs, microporous rubber cushion, rubber pads under rail, fasteners and rails are factory prefabricated parts or standard products, which can ensure good homogeneity of their performance. Compared with the ballasted track, the overall structure of the track has better structural continuity and elastic uniformity, which provides favorable conditions for improving the smoothness of the track and improving the ride quality.

1.2. Good Structural Stability and Stability

In the ballastless track structure, the track transverse resistance and track longitudinal resistance, which are the calculation parameters of CWR stability, are no longer dependent on the ballast bed with changeable material and state. Its integral under rail foundation can provide higher and more constant longitudinal and lateral resistance for CWR, with better durability and longer service life.

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1.3. Good Structural Durability and Less Maintenance Performance

Ballastless track adopts integral under rail foundation. Compared with the ballast bed foundation with granular structure, the track bed structure deformation caused by the abrasion, pulverization and relative dislocation of ballast particles will not occur under the train load, and the deformation accumulation will not occur under the repeated action of train load, so that the change of track geometry size is basically controlled within the factors such as the looseness and wear of rubber pad, fastener and rail under the rail, thus greatly reducing the track deformation The change rate of track geometry state can reduce maintenance workload, prolong maintenance cycle and track service life.

1.4. Public Works Maintenance and Maintenance Facilities Reduced

As the maintenance workload is reduced, the jurisdiction of each comprehensive maintenance center and maintenance work area can be extended, thus reducing the number of maintenance departments mentioned above. At the same time, it can also reduce the number of maintenance machinery, parking tracks and houses in each department.

1.5. Avoiding Ballast Splashing of Ballasted Track under High Speed Condition

The running test of Qinhuangdao Shenyang passenger dedicated line before the opening of the line shows that when the running speed reaches 250km / h, the ballast in the center of the track will fly, which will cause the axle and brake cylinder of the bogie to be hit by ballast. According to the operation experience of TGV railway in France, when the train speed reaches 350 km / h, ballast splashing occurs seriously. When the speed is reduced to 320km / h, the phenomenon will be improved. After the maintenance of ballast bed, due to the loose surface ballast and more powder particles, flying debris will also be produced. At this time, the speed limit is 170km / h.

1.6. It Is Conducive to the Selection of Route to Adapt to the Terrain and Reduce the Project Investment of the Line

The longitudinal and transverse stability of ballastless track is much higher than that of ballasted track. In the section where the route selection is difficult, the advantage that ballastless track can bear large wheel rail lateral force can be used. Under the premise of ensuring comfort, the limit of allowable superelevation and under superelevation of curve can be appropriately relaxed, and the minimum curve radius can be reduced, so as to facilitate route selection and reduce engineering quantity.

2. Ballastless Track Type

2.1. Boge Slab Ballastless Track

The predecessor of Borg slab ballastless track system is a kind of precast slab track laid in Germany in 1979. Through the optimization and improvement of prestressed structure, structural size, longitudinal connection and other aspects, the advanced CNC grinder is used to process the rail groove on the prefabricated track slab, and the rapid and convenient measurement system is used to provide the appropriate stiffness and elasticity for the track. The construction equipment of Boge track slab is complete, and the degree of mechanization is higher than that of general track structure. Boge slab ballastless track can be used in high-speed railway of 300km / h.

2.2. Ziiblin Ballastless Track

The Ziiblin non broken track system was developed in, and successfully laid on the Cologne Frankfurt high speed railway. Xuprin ballastless track system is similar to type II ballastless track system. Both of them lay double embedded ballastless track on the hydraulic concrete bearing layer, but the construction technology adopted is different. It is characterized in that

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the track slab concrete is poured first, then the double block sleeper is installed in place, and the sleeper is embedded into the compacted concrete by vibration method until the accurate position is reached.

2.3. Slab Ballastless Track in Japan

Japan's ballastless track technology is mainly represented by Shinkansen slab track structure. In the 1970s, slab track was promoted as the national standard of railway construction in Japan. Therefore, the slab track is widely used in Japan. Up to now, the accumulated laying mileage of slab track has reached more than 2700 km. At present, there are common A-type track, frame type track board, anti vibration track board used in special vibration reduction section, and early type track board used on subgrade.

3. Technical Difficulties in Ballastless Track Construction

3.1. Control Track Subgrade Settlement

Settlement control of ballastless track subgrade structure is one of the main technical difficulties in its construction. Because the foundation structure is easy to be affected by external factors, such as deformation and collapse, at the same time, the relevant fastener function of ballastless track will be changed to a certain extent due to the settlement of subgrade, and these uncertain changes will increase the technical difficulty of subgrade settlement control in ballastless track construction.

3.2. Accurate Positioning of Track Laying Position

When the construction technology of ballastless track is applied in the construction of high-speed railway engineering, it puts forward high requirements for the construction technology level and measurement accuracy. Therefore, the traditional measurement technology has been difficult to adapt to the accuracy of track laying and positioning in the construction of ballastless track benchmark measurement. Therefore, the construction unit must attach great importance to this technical difficulty and strengthen the relevant measurement technology The R & D and application of the technology can provide reliable guarantee for the quality of high-speed railway track construction and train operation safety.

3.3. Accurate Control of Track Size

In the construction process of ballastless track, it is also one of the technical difficulties to accurately control its geometric dimensions, which is mainly due to the fact that the geometric dimensions of the track must be controlled in place at one time during the construction of ballastless track. In addition, ballastless track also needs to strictly control its linearity, which also puts forward higher requirements for construction technology, which has become a technical difficulty in the construction of ballastless track.

3.4. Accurately Control the Equilibrium of Track Stiffness

In the ballastless track construction of high-speed railway project, the construction unit should strictly abide by various operation specifications and technical standards, so as to ensure that the stiffness of ballastless track can meet the design requirements and maintain balance. This is not only related to the stability and safety of the overall structure of track engineering, but also one of the difficulties that must be paid great attention to in the construction of ballastless track.

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4. Effective Measures for Construction Technology Control of Ballastless Track

4.1. Effective Technical Measures to Control Foundation Settlement of Ballastless Track

Compared with the traditional ballasted track, ballastless track structure has higher strength, more balanced stiffness distribution and better stability of the overall structure, which is the main structure composition in high-speed railway engineering. In the construction of ballastless track, the technical parameters should be determined in strict accordance with the construction requirements and design standards, and the deformation trend should be accurately controlled. In the construction process, we should actively adopt the advanced subgrade construction technology, reasonably select the subgrade structure form of ballastless track, and then strengthen the quality control of filling and pouring construction operation, so as to improve the standardization and standard of subgrade construction. Through the summary of track foundation construction experience and Research on settlement control, in order to break through the technical difficulty of subgrade settlement control in ballastless track construction, it is necessary to strengthen the survey of subgrade construction area before construction, fully understand the relevant factors that may affect subgrade settlement or deformation, and accurately analyze the causes of settlement. In the construction process, after the foundation structure reaches a reliable and stable state, strict inspection shall be carried out according to the construction technical standards, and the follow-up track laying construction can be carried out after the inspection is qualified. If the construction of high-speed railway culvert or bridge is needed, the stability of its foundation structure should be ensured first, so as to ensure that the construction quality of ballastless track can meet the construction requirements of high-speed railway engineering.

4.2. Effective Technical Measures for Controlling Positioning Accuracy of Ballastless Track

In the construction of ballastless track, it is necessary to carry out laying survey, offline measurement and completion survey respectively, and control its positioning accuracy at millimeter level to ensure that the construction quality meets the design standards. In order to break through this construction technical difficulty, the construction unit should actively adopt advanced measuring equipment and technical methods to improve the measurement accuracy, so as to ensure the accuracy of track laying positioning and linear positioning. During the laying survey of ballastless track, the construction unit shall strictly abide by the survey operation specification, and strengthen the inspection of CPI, II and III control network of survey elevation network. During the survey, it should be noted that the survey length should not exceed 2km, and the distance between points should be controlled at about 150m. At the same time, the distance from the center line of the line should be about 4m. After the survey planning is completed, the concrete is used for the construction of the control points to avoid the influence of hard and plastic environment on its accuracy, and the second-order leveling points are opened and closed. When the elevation survey is carried out, the accuracy of the survey should be improved by the level gauge and the longitudinal deployment mechanism, and the length of the leveling traverse shall not exceed 2km. For the construction of casting ballastless track unit slab, the construction personnel shall first install the benchmark in place, so as to timely and accurately adjust the track slab shape and the laying positioning of unit slab, so as to ensure the accuracy of horizontal position, elevation and direction of ballastless track. During the completion survey, the track geometry and the accuracy of pile foundation should be retested by using advanced measuring instruments such as total station to ensure the construction accuracy.

4.3. Effective Technical Measures to Control Linear Dimension of Ballastless Track

In the construction process of ballastless track, in order to break through the technical difficulties of geometric dimension control and linear control, the construction unit should strictly control the model, size and quantity of all track structural members, fasteners and joints according to the design standards. When installing the rail joint, the relative installation technology should be adopted, and the distance between the insulation section and the sleeper should be controlled above 70mm. At the same time, the length of unit track should be controlled according to the stress release requirements in the construction of ballastless track. Generally, the length of unit track should be controlled between 600m and 1800m, and the excess of outer track and track size should be accurately controlled according to the design requirements. Ballastless track should be polished before installation, and its straightness error should be controlled within 0.3mm, and the error of track cross section should be controlled within 0.2mm. During the installation and construction of ballastless track, on the basis of the straightness of the wrapped pile track, the rail surface elevation error should be controlled between 4mm and 6mm, and the error between lines should be controlled within 8mm. It should be noted that the error value of track center line should be strictly controlled within 2mm. In order to improve the geometric dimension of ballastless track and the precision of linear control, the height detection accuracy can be avoided by preset high track and other factors, such as screw torque or support degree, so as to accurately control the geometric dimension of track peripheral structure. In order to ensure the safe and smooth operation of the high-speed railway, attention should be paid to the precision of the adjustment when controlling the size of the inner wall structure of the track. In addition, when welding the rail joint, the joint should be strictly controlled to improve the track geometric specifications and linear accuracy.

4.4. Effective Technical Measures to Control the Rigidity of Ballastless Track

When there are road bridge connection sections in high-speed railway engineering, it is necessary to keep the consistency of ballastless track stiffness. In order to solve the technical difficulty of keeping the ballastless track stiffness balanced, the construction unit should formulate scientific construction procedures and corresponding technical standards, especially reasonably control the structural type and length of the road bridge connection. At the same time, pay attention to strictly control the quality and performance of construction materials such as cement sand frame, and improve the rationality of its proportion. In the preparation of materials, the mixing should be sufficiently uniform to ensure the consistency of its performance index.

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