Analysis of Construction Technology for Long-Span Beam-Arch Composite Steel Bridges in Municipal Road and Bridge Projects

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Abstract: Municipal road and bridge engineering is one of the most crucial components of China's municipal engineering. The selection and application of construction technology are vital during municipal engineering construction, necessitating the development of a targeted and comprehensive construction technology system for municipal road and bridge projects. Currently, the application scope of long-span concrete continuous beam construction technology is continuously expanding, forming a construction technology system for long-span beam-arch structures. Particularly for composite steel bridges, their application in municipal road and bridge engineering significantly enhances the structural stability and service life of projects, meeting the specific requirements of modern road and bridge construction in China. Based on this, starting from the analysis of long-span beam-arch structure bridge construction, this paper specifically explores the key application points of long-span beam-arch composite steel bridge construction technology in municipal road and bridge projects, hoping to provide valuable experience for future municipal road and bridge engineering construction.

1. Introduction

Based on the current social background, Chinas socio-economic level and modernization development are improving continuously. At the same time, municipal road and bridge engineering projects have larger project scales, a higher proportion of work sites occupied and an increasing number of construction phases. In order to realise the effective guarantee of qualities, advantages and construction life which eclectivs by municipal road and bridge projects is told about the idea, a special construction technology scheme should be established & an improved such constructions technologically. Now, long-span beam-arch steel bridge construction technology has been extensively applied in municipal road engineering projects in China and its application scope is still expanding. It increases the overall structural stability of municipal road projects and is in line with the modernization and sustainable development requirements for China's highway construction industry. And, in the construction of long-span beam-arch steel bridge technology, technical difficulties are more prominent and its main performance is the requirement of high standards for various professional technical standards and relatively high demand for professional quality of construction technicians. The long span beam-arch steel construction technology in China at present is mainly two kinds of structure types, steel truss structure or composite structure.

For steel truss structures they are most often worn from small-size road and bridge engineering. Not only do they offer good control of structural stability and construction quality, but also represent a new architectural form that can control the cost of construction. It has particular advantages in the application of municipal roads and bridges With steel box girder composite structures, to ensure its stability and seismic resistance. This type is usually only appropriate for bridge span larger than 300m and less than 500m, can satisfy the Chinese modern municipal road and bridge construction requirement.

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2. Analysis of Construction Difficulties in Long-Span Beam-Arch Composite Steel Bridges

2.1 Difficulty in Controlling the Stiffness of the Bridge Main Girder

In the construction of long-span beam-arch composite steel bridges, compared with other forms of steel bridges, some problems still exist in the construction technology, even though it is beneficial. Certain bridge main girder structures have low stiffness, and some are forced to sacrifice low deck slab heights. This could be due to the upper structure of the bridge using a composite section form with a steel-concrete relationship. For this type of structure, it may also be bracketed by structural slippage during the remaining service life of the bridge in regards to overall Bridge structure stability [1]. Therefore, in the construction of long-span beam-arch composite steel bridge Projects from the perspective of ensuring that such structures are stable and safe during service and do not affect people's lives and property, a good construction of introducing main girder alignment work. Strengthening control and management of the structural stiffness for main girder to reach engineering requirements, so that reduce the possibility of structural slippage within the service life of bridge.

2.2 Difficulty in Controlling the Longitudinal Curvature of Steel Cross Girders

Long-span beam-arch composite steel bridges were constructed in conjunction with a longitudinal construction method for the steel cross girders. As one of the important works that must be carried out in the construction process, controlling the longitudinal curvature of steel cross girders is a prerequisite for ensuring bridge engineering construction quality. In large span bridge engineering, if the longitudinal curvature of steel cross girders is too great, it will often give rise to local structure fracture even collapse during follow-up construction and service lapses, resulting in very serious engineering accidents and irreplaceable property losses [2]. Thus, the long-type bridge project construction should focus on strengthening field monitoring and supervision during multiple construction periods, and developing sound on-site construction safety management plans to actively cope with the above difficulties. This is especially critical in determining the longitudinal curvature of the steel cross girders to find whether or not they meet engineering construction requirements, so subsequent construction can only be carried out if under standard.

3. Exploration of Key Points of Long-Span Beam-Arch Composite Steel Bridge Construction Technology in Municipal Road and Bridge Engineering

The construction quality and safety of municipal road and bridge engineering in the field directly relates to the urban development of Chinese, which is an important symbol of social modernization. So when building municipal road and bridge projects, construction technology system shall be continuously optimized. Particularly given the current background in which the technology levels of long-span composite steel bridge construction are continuously improving, this technology should be adopted into municipal road and bridge projects to improve their construction level, thus giving impetus to the sustainable development of China's urban road and bridge engineering sector.

3.1 Key Points of Steel Girder Structure Construction Technology

Steel girder structures have already been widely applied on municipal road and bridge engineering construction in China. Through optimization and use of steel girder structures, this has notably enhanced the structural stability of bridges, especially for municipal bridge single projects. Now the structural types for single bridge projects in steel girder construction are mainly double-tower multi-span prestressed concrete continuous steel rigid frame bridges and simply-supported truss stiffened girder arch bridges. Both of these two types have their positive points. No connection node between the tower pier and the main cable for double-tower single-span prestressed concrete continuous steel rigid frame bridge. In addition, the average height of the tower is normally greater than that of the deck elevation as the ends of a major girder are secured by metal cable to 2 members coincident with the design line center. When realizing the structure, this will ensure the overall structural stability without greatly increasing construction cost and has obvious

advantages in single projects [3]. In the future, focus of research on the above steel girder construction technology for further improvement of the stability of steel girder structure overall to get comprehensive quality and benefits in road bridge engineering in city.

3.2 Key Points of Steel Box Girder Construction Technology

Furthermore, steel box girder construction technology has now become a main technical component among the long-span steel bridge engineering constructions of modern municipal road and bridge engineering constructions. In order to guarantee the quality of steel box girder construction and bridge structure overall stability, the following technical points should be confirmed:

3.2.1 Structural Modeling Points

BIM(Building Information Modeling) three-dimensional modeling technology is information technology-based and has been applied in China municipal road and bridge engineering construction. A: In the process of construction, steel box girder should be used as a tool for 3d modeling technology to realize more effective optimization of engineering construction management model. First, it is to identify the sizes and installment locations of steel box girder components during the construction stage. Once the pre-required parameters are calculated, targeted finite element analysis calculations for different construction phases after determining proruption situations (contingencies) could be simulated with respect to the real estate 3D model [4]. Based on the latest Aero model, this construction BIM 3D model would allow visualization of purposeful site construction within different phases acting at different granularities, which significantly assists Construction Manager Macro-Supervision and Control.

3.2.2 Welding Operation Points

There are welding operations in the construction of steel box girder, and its implementation partially determines the stability of the steel box girder structure, which has an effect on final engineering construction quality. Hence, it is mandatory to exercise technical supervision and control of welding related operations. This should start from several stages: material preparation (making and thermal predetermined welding rods), practical cutting of weld seam, cooling down to the room temperature. However, the requirements of welding process for different models and specifications of steel materials are also inconsistent. In order to stabilize welding at the junction and ensure the bearing capacity of the bridge, it is necessary to control temperature changes during welding operations in accordance with a certain suitable temperature [5]. Meanwhile, assembly welding is also needed during construction as welding technicians are required to have excellent skill levels. In the case of some long-span bridges, there are many phases in a welding process and also many tasks of assembly welding. During operation, novice installation based personnel are likely missed welds or wrong welds. Therefore, strengthen the management of on-site walk, and strictly in accordance with the requirements of welding operation sequence in construction drawing. Furthermore, the ambient temperature has to be controlled appropriately in order to minimize freeze-thaw cracks from being produced in steel and thus serve the overall quality of welding operations for steel box girders [6].

3.3 Key Points of Support System Construction Technology

In municipal road and bridge engineering, the construction of support system is one of the important components for masterizing long-span beam-arch composite steel bridges. The major components of the support system are PC steel structure (steel pipe piles, precast beam elements, and so on). The system has significant supporting role and basic guarantees road and bridge structure stability. Thus, the support system construction technology program must be rationally designed. In the long span municipal road engineering construction situation of our country, the main frame and secondary frame structure mode shall be used in support system construction [7]. For road and bridge engineering, because the support can counteract external loads, achieve good shock absorption effect, and effectively reduce the possibility of foundation settlement and even

structural collapse.

In the process of constructing a specific support system, if it is located in an expansive environment such as various large-scale engineering facilities (surrounding buildings, bridges), the construction plan should be formulated according to the support systems crack preventing deformation performance. Which guarantees the stability and safety of long-span steel bridges. Long-span road and bridge structures specially subjected to high work environment, for example, high temperature, low temperature and high air humidity. Examples include diseases such as cracks in the deck slab, which mislead serious damage to the load-bearing capacity of the road and bridge structure. That is, when the support system of long-span bridges are constructed, their load (i.e. the forces affecting the stability of its structural span) within should be dissipated in terms of surrounding abutments and piers by ensuring that they have enough strength to endure it; which would also strengthen the main steel skeleton at this point [8]. But for some of the municipal road and bridge engineering, can use steel materials used steel, skeleton structure formed may be under the action of atmospheric weathering (wind, frost, rain and snow) gradually lost mechanical property or even structural damage occurs collapse results in partial scrapping of components or whole scrap bridge structure. So at the very beginning of steel material selection, it is necessary to strictly require rust resistance of the steel, so that all climatic factors can affect its main steel structure over passing service life. This is also vital in guaranteeing the service life and stability of long-span bridge structures [9].

4. Conclusion

In brief, the modernization level of China's municipal engineering has been continuously improved and is a reliable basis for urbanization characterized by integrated urban-rural development. In the road and bridge engineering project, to ensure the quality of the projects and maximize or comprehensive benefits, traditional road and bridge construction technology should preferably innovate actively in the future when undertaking municipal works so as to make up a more mature construction technology system. Nowadays, it is becoming regularization that bridges with long-design span are redone projects according to China's modernization background, having a solid structure stability and long service life. Timely introduction of long-span beamarch composite steel bridge construction technology in the development of municipal engineering road and bridge. The selection of the composite steel structure should not only be based on building features and various design requirements but also factors like project scale, functional attributes, and climatic environmental conditions all need to be comprehensively considered so that the load-bearing capacity of the main structure meets municipal road and bridge engineering standards. The core content of long-span beam-arch composite steel bridge construction technology in municipal road and bridge engineering should be clarified specifically, which is mainly embodied in steel girder structure construction technology, steel box girder construction technology, support system construction technology and so on. Based on the analysis of the above-mentioned construction techniques, more ideas can be provided for long-span composite steel municipal road and bridge engineering projects in order to better ensure the quality and high efficiency of follow-up municipal engineering construction.

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