

Discussion on Key Technologies of Cast-in-place Box Beam Construction in Highway Bridge Construction

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Abstract: *In recent years, with the development of the economy and social progress, highway bridge engineering has gradually received high attention from all sectors of society. On this issue, researchers point out that highway and bridge engineering often has an important impact on urban transportation capacity. Based on this, in order to effectively ensure the reasonable satisfaction of transportation needs during urban development, relevant departments should pay close attention to the construction of highway and bridge construction issues in a reasonable manner, thereby further ensuring the comprehensive improvement of the quality of related engineering. Overall, one of the most important technologies during the construction of highway and bridge engineering is the scientific application of prestressed technology, which helps to ensure the reasonable improvement of engineering construction level and has a significant impact on the quality of engineering in China. In this article, the author analyzed and summarized the common problems of prestressed technology in highway bridge construction based on a large amount of research data, and provided solutions for specific problems, aiming to comprehensively promote the scientific application of force technology in highway bridge construction.*

Keywords: highway bridges; Key points of construction; Prestressing technology; Main issues; Solutions.

1. INTRODUCTION

A large amount of research data shows that during the construction period of highway and bridge engineering, one of the most important technologies is the application of prestressed technology, which often helps construction units to achieve scientific construction of engineering structures in a reasonable manner. It has an important impact on the quality and lifespan of the project. Based on this, in recent years, with the increasing demand for transportation capacity in urban development, a large number of construction units and researchers have analyzed and summarized the application of stress technology during highway bridge construction, hoping to promote the scientific application of this technology in a reasonable manner. During this period, by combining relevant data for analysis, researchers analyzed the common problems in the use of pre force technology during highway bridge construction and provided corresponding optimization suggestions.

As one of the important technical forms during engineering construction, prestressed technology can reasonably help improve the crack resistance of concrete components, help ensure the reasonable improvement of structural durability in engineering projects such as highway bridges, and has important promoting significance for the increase of project performance and service life. At the same time, another advantage of prestressed technology is that it can help highway bridge engineering achieve reasonable reduction of structural cross-sectional size and self weight during construction, which has positive significance for optimizing the height of concrete components and avoiding deformation problems [2]. Taking bridge engineering as an example, during the construction period, the main contents involved in prestressed structures include T-beams, prefabricated slabs, and flexural components. A large number of practices have shown that the scientific application of prestressed technology is beneficial for promoting the improvement of bridge tensile and bending performance, and is crucial for optimizing the overall quality of engineering.

2. APPLICATION OF PRESTRESSED TECHNOLOGY DURING HIGHWAY BRIDGE CONSTRUCTION

Digital art has gradually become a major means of cultural heritage conservation with its unique forms of expression and dissemination. Taking the Yu Tombs as the background of the study, the Yu Tombs art resources were digitally displayed and data collected, using digital video and non-linear editing to digitally record and display the ancient architectural complex on the one hand, and using 3D laser scanning, reconstructed 3D models and virtual displays to digitally preserve and promote stone art resources. The transformation of Yuling art

resources into digital information resources and the use of digital technology to establish a Yuling art resource library will facilitate the dissemination and promotion of Yuling art resources, extend the digital conservation pathway and allow for the permanent preservation of art resources. Located 23 kilometres west of Zunhua, Hebei Province, in the Changrui Mountains, the Yu Tombs were built by Qing Emperor Aixinjueluo Hongli, whose reign name was "Qianlong", which means "Heavenly Way Prosperous". Built in 1743 and completed in 1752, it is the most exquisite and complete royal tomb among the existing underground palaces open to the public, and is rich in artistic resources, including standard-style Lei architecture and stone carving.

2.1 Application in T-beam structures

From a structural perspective, the application of prestressed technology in highway bridge concrete. The application of T-beams is relatively frequent. Overall, a large amount of research data shows that during the construction of T-beams, the reasonable application of pre-stressing technology can generate reverse tension on the T-beams, thereby ensuring that the T-beam force is maintained in a balanced state [3]. During this process, construction units often use the pre tensioning method during the construction of long bridge projects, in order to effectively promote the reasonable optimization of the strength of the T-shaped beam and provide assistance for the quality assurance of bridge engineering.

The most distinctive of the artistic resources of the Yu Ling are the ancient buildings and stone sculptures, which are divided into above-ground and underground buildings, and stone sculptures, which are divided into stone statues and stone altars, as described below.

(1)The above-ground buildings are divided into a front part and a back part, and in terms of architectural style the Yu tomb buildings come from the Style Ray family, which conveys endless wisdom in its architectural philosophy and actual construction.

(2)The underground building is commonly known as the underground palace, which is a traditional arch and scroll stone structure consisting of nine coupons and four doors. Inside the palace are carvings of Buddhist motifs and designs, as well as over 30,000 words of Tibetan and Sanskrit mantras.

(3)The stone statues also known as wengzhong, are part of the art of tomb carving, which in ancient times served to ward off evil spirits and symbolise the status of the tomb owner, the status of the tomb, the specifications of the tomb and the solemnity of the atmosphere. There are a total of eight pairs of stone statues in the Yu Tomb which are vividly carved in the form of roundels, openwork, reliefs and line carvings.

(4)The stone altar (Stone Five Offerings) is also divided into two parts, the altar and the five offerings, and is a symbolic altar with a stove, two candlesticks and two vases, the decorative motifs of which are mainly carved in shallow relief. The stone five offerings are symbolic of the ritual architecture, and this symbolism conveys the hope of good fortune and prosperity, peace and tranquillity.

2.2 Application during bridge reinforcement

In daily applications, bridges are often susceptible to various external factors. A large amount of investigation data on this issue shows that factors such as traffic, weather, and flowing water may affect the stability of bridges, which is not conducive to the reasonable maintenance of bridge engineering performance and increases the risk during its use. Based on this, during the construction process, relevant units should actively consider the particularity of bridge engineering and effectively reinforce it [4]. Overall, in the process of strengthening old bridge projects, construction units often use specific reinforcement components for treatment, in order to effectively promote the comprehensive optimization of bridge engineering's bearing capacity and durability. During this process, actively applying external prestressing is beneficial for helping the bridge achieve sufficient reinforcement, which has positive significance for fully weakening the bending moment effect and preventing component instability issues.

Digital conservation encompasses virtual reality, 3D image technology and stereoscopic projection technology to digitally convert physical heritage information into a visually visualised digital image to achieve a visual 3D reproduction[1]. Digital conservation uses digital technology to acquire data and image information, to preserve and reproduce heritage digitally and to create a digital heritage information resource for permanent circulation. The advantages include efficient access to data information and the availability of highly accurate point cloud data.

Finished videos, models and images are disseminated through the media, enabling data and image information to be shared. Virtual displays and panoramic video displays are digitised and visualised. Research into the conservation of cultural heritage resources using digital technology has been applied in the conservation of numerous ancient cultural heritage sites.

2.3 Application in prefabricated panel equipment

As one of the most common structures in highway bridge engineering, prefabricated panels often have a direct impact on the performance of engineering projects. During this period, researchers pointed out that actively introducing pre-stressed technology for design during the manufacturing phase of prefabricated slabs can help promote the full enhancement of the prefabricated effect of prefabricated slabs, Strengthening its seismic resistance and stability is crucial. Meanwhile, some studies have shown that during the production process of prefabricated panels, relevant units should actively select steel strands with high strength and low relaxation characteristics as raw materials for construction [5]. The digital conservation of art resources at Yuling caters to the needs of the public to visit and experience art and culture in the age of digital technology. In the new era of open public art resource platforms, the cultural conservation of Yuling art resources is an inheritance, borrowing and assimilation of artistic creativity and diverse styles, using Yuling art as a new aesthetic resource[2] . Digital conservation plays an important role in Yuling art resources.

2.4 Application in bending components

During the construction of highway bridges, construction units often use carbon fiber materials as raw materials for bending components. Overall, this type of material has relatively stable performance and relatively high strength, which is conducive to comprehensively meeting the load-bearing needs of engineering projects and has good promoting significance for the improvement of China's transportation capacity. The use of digital technology for development and conservation in historical and cultural research and art resource conservation, the establishment of a digital display resource library, and the digital conservation of the existing stone art and the ancient architectural complex of the Yuling. The digital conservation of Yuling's art resources is carried out in conjunction with the conservation of cultural heritage to obtain 3D model data resources, while selecting Yuling's art resources for a thematic documentary film. The design language and aesthetic features are applied to the conservation of Yuling art resources to improve the digital presentation[3] , to preserve Yuling art and culture in a comprehensive, detailed, accurate and timely manner, to help rationalise and integrate Yuling art resources, and to enhance the cultural and artistic value of the Qing Dongling Scenic Area.

3. COMMON PROBLEMS OF PRESTRESSED TECHNOLOGY IN HIGHWAY BRIDGE CONSTRUCTION

The digital information age continues to develop, providing more ways to disseminate and distribute information, The use of digital technology methods allows for the wider dissemination of Yuling art resources. In the process of art resource dissemination and promotion to expand the influence of the Qing Dongling, including for the digital conservation of ancient architecture and stone carving art, combined with the Internet platform release, providing more complete image material and data information, so that the ancient architecture and stone carving art resources to obtain a more mature dissemination of meaning, to achieve better protection and inheritance of Yuling art resources. Based on digital technology to achieve the digital conservation of art resources, expand the publicity of the Yu Ling art resources to protect the way to study the development and use of historical and cultural digital are a help to cultural heritage. Due to the large number of ancient the abundance of stone art resources, a digital information resource database was established to categorise and store model data, pictures, text and image information to achieve resource sharing and dynamic conservation. As the Qingdongling Scenic Area lacks online display and tour functions, video content, image content and 3D models for online digital dissemination are produced, and 3D animations are produced to introduce the types of stone carvings and panoramic videos for thematic ancient architecture documentaries.

3.1 Uncontrolled tensioning force

In the construction process of highway and bridge engineering, as the main executor of specific work, the professional ability of construction personnel often has a significant impact on the quality of engineering construction. On this issue, some research data shows that at present, the professional abilities of some construction personnel in construction units are relatively weak. At the same time, a small number of construction

personnel have not received professional competence training, which makes it difficult for them to actively carry out scientific construction of engineering structures in accordance with relevant technical standards during the construction phase, resulting in significant safety hazards during the construction process. For example, some construction personnel deviate from the design requirements during the construction of the tensioning force, resulting in relatively poor stability of the reinforced concrete structure, which can easily lead to collapse during equipment use, which is extremely detrimental to engineering safety. At the same time, some construction units are prone to using early strength agents or increasing the proportion of concrete during the construction period, which leads to excessive loss of transportation capacity during the construction period and is not conducive to ensuring the safety of the engineering project.

3.2 Blockage of prestressed pipes

Overall, during the construction period, due to weak engineering technical capabilities and a lack of management systems, some construction personnel often find it difficult to strictly follow the design drawings for the scientific layout of steel pipes. Due to the impact of this issue, related pipeline projects are often prone to problems such as looseness and twists after completion, thereby increasing the risk of engineering projects. At the same time, a large amount of research data shows that during the construction period, due to the lack of effective scientific sealing of corrugated pipe joints, the prestressed steel pipes in engineering projects are often prone to blockage, which in turn affects the reasonable satisfaction of the steel strand threading needs. Due to the obstruction of this issue, the tensioning effect of steel strands often decreases, which is detrimental to the maintenance of the overall quality of the project.

3.3 Fracture of prestressed components

Researchers have stated that during the construction and use of highway bridge engineering, prestressed components are often prone to fracture due to external forces [7]. Overall, this issue is mainly caused by external pressure on the project exceeding the ultimate strength of reinforced concrete components. From the perspective of engineering safety, once this problem occurs, it is often easy to have an impact on the stability of highway bridge engineering, which in turn buries safety hazards for users.

4. STRATEGIES FOR OPTIMIZING THE APPLICATION LEVEL OF PRESTRESSING TECHNOLOGY IN HIGHWAY BRIDGE CONSTRUCTION

Digital photography, panoramic video, non-linear editing, virtual reality, 3D laser data acquisition, 3D models and virtual displays are used to preserve and display the digital data of Yuling's art resources, relying on digital technology to take Yuling's art resources as the centre of conservation and move towards visualisation of images, video and immersive interactive direction of conservation. This broadens the scope of the original conservation to be confined to the protection of the relics themselves, and realises the digital conservation of Yuling's art resources in terms of both historical and cultural heritage values. The use of network media for real-time 'updating' and 'protection', to achieve the dynamic effect of receiving information to transmit the complete information, while ensuring the authenticity of data and information integrity, so that the content and dissemination of digital conservation of ancient architecture and stone art It is a dynamic and immersive interaction. The following is a specific approach to digital conservation, summarising the steps taken to realise the specific application of digital technology in the conservation of Yuling's art resources through preliminary research, the collection, collation and combination of early material.

Digital video refers to a variety of technologies that capture, record, process, store, transmit and reproduce a series of still images as an electrical signal.[4] Digital video is played, received and circulated on computers, mobile phones and mobile information terminals on the Internet, and therefore has the function of inheritance and continuity of preservation, and is increasingly used in the conservation of cultural resources today. Firstly, digital photography is used to capture footage of ancient architectural resources, secondly, non-linear editing software is used to group footage and synthesise digital effects to achieve smooth visual effects and enrich the content of the images, and finally, panoramic video is used to achieve a panoramic tour of virtual space.

4.1 Cultivate the technical ability of construction personnel

In order to effectively ensure the scientific application of prestressed technology during the construction of highway bridges, relevant construction units should actively pay close attention to their internal talent team,

thereby increasing the absorption of talents and promoting the comprehensive construction of high-quality construction teams. At the same time, for existing construction personnel, the construction unit should regularly organize systematic learning and analysis of emergency professional skills, in order to guide construction personnel to further improve and optimize their comprehensive construction literacy, and ensure the reasonable maintenance of construction work level. During this period, a reasonable construction of the internal team of staff should be carried out in the form of leading the old with the new, and promoting the reasonable inheritance and development of excellent construction experience, ensuring that construction personnel can strictly comply with technical requirements during the construction period and actively carry out reasonable construction and construction within the project. At the same time, in the process of organizing the construction team to learn specialized knowledge, the construction unit should actively give reasonable lectures on the importance of construction, in order to help construction personnel further clarify their responsibilities and missions, and ensure that they fully realize the reasonable strengthening of their sense of responsibility.

4.2 Actively Implementing the Introduction of Advanced Construction Technology

Overall, in order to effectively promote the scientific application of prestressed technology in the construction process of highway bridges, relevant enterprises should pay close attention to scientific research work in a reasonable manner, actively carry out regular innovation of construction technology and equipment during the construction period, ensure the reasonable introduction and application of advanced construction techniques, and improve the comprehensive level of construction work [8]. During this period, they should reasonably conduct systematic analysis and induction of construction work issues, and then formulate corresponding optimization plans based on specific problems. During the construction process of prestressed steel bars, scientific selection of steel bar tensioning methods should be actively made based on the actual needs of the project. Overall, the commonly used tensioning methods for prestressed steel bars can be divided into three forms: batch tensioning, end to end tensioning, and single end tensioning. Among them, the batch tensioning mode is mainly applicable to components equipped with multi speed prestressed steel bars. In this process, considering the later batch of prestressed steel bars, it often has a certain impact on the elasticity of the concrete during tensioning. Therefore, when constructing the pre tensioned prestressed steel bars, relevant personnel should pay close attention to and consider the elastic compression loss value in a reasonable manner. The tensioning method at both ends is mainly applicable to linear prestressed steel bars with a strength greater than 30 meters. The method is mainly applicable to straight lines with a length of no more than 30 meters. Prestressed steel bars. From the perspective of construction, actively combining the actual needs of the project to select and apply construction techniques can help achieve a comprehensive improvement in construction level.

4.3 Improve the management system for the use of construction materials

In the construction process of highway bridges, the quality of construction materials often has a significant impact on the overall performance and service life of engineering projects. Therefore, The construction unit should reasonably formulate and improve the construction material management system during the construction period, ensuring the scientific selection of construction materials in accordance with the needs of prestressed technology. During this period, anchors and steel strands are important issues that construction units should focus on. In the process of selecting construction materials, relevant units should analyze and establish the dimensions, performance parameters, and specifications of steel strands based on the engineering design and actual situation [9]. During this process, in order to achieve sufficient control of pre-stress, the construction unit should actively choose mechanical anchoring methods for engineering construction. At the same time, during the installation of pipelines and steel reinforcement molds, relevant personnel should reasonably conduct sufficient analysis and control of the performance of engineering materials. During the construction process of concrete structures, relevant units should reasonably select early strength agents and actively control the quality of construction materials to ensure that the properties of selected materials such as cement, sand, and steel meet the requirements.

4.4 Reasonably Strengthening Construction Quality Supervision

After formulating and improving the specific work system, the construction unit should actively establish an effective supervision team, so as to assign a dedicated person to properly supervise the specific situation during the construction period of highway and bridge engineering, ensuring that the above formulated system can be truly implemented, in order to achieve a reasonable guarantee of the comprehensive quality of highway and bridge engineering. During this process, the construction unit should reasonably pay effective attention to and adjust the control mode. During this period, it can combine advanced information technology to develop a construction

control platform for engineering projects, in order to further achieve global observation and dynamic analysis of the construction situation of various structures during the construction period of engineering projects, ensuring that construction work is truly fully managed [10]. Practice has shown that by actively combining network technology for sufficient supervision, it is beneficial for regulatory personnel to reasonably record and remotely monitor the tensioning process of prestressed steel bars, thereby ensuring strict control of construction quality. This has positive value for optimizing the construction level of engineering projects and controlling the randomness during tensioning operations. At the same time, in the process of supervision, timely identification of potential problems and tasking relevant personnel to solve them can help ensure the comprehensive improvement of the performance of highway and bridge construction projects. The digital video is shot in 2048 x 1080 high resolution image quality, with digital photography of the Yu Ling scenic area including above ground buildings, underground buildings and stone art, to truly show the Yu Ling art culture and historical background. The overall architectural outlook of the Yu Tombs, with the central axis as the main focus, from the God's Kitchen, the West Dynasty Room, the East Dynasty Room, to the three - way, three - hole stone arch bridge, dragon and phoenix pillars, the Longen Gate, the West Hall, the Longen Hall, the East Hall, the Mausoleum Gate and so on, in accordance with the history or layout of the direction of filming, using documentary techniques to highlight the historical background, with long shots to record the full picture of the ancient architecture of the Yu Tombs.

5. CONCLUSION

From the perspective of building construction, as a commonly used technology in the construction process of large-scale projects such as highways and bridges, the application of prestressed technology can effectively help construction units in fully addressing the durability issues of reinforced concrete structures is beneficial for promoting the comprehensive improvement of engineering performance. Based on this, with the continuous acceleration of urbanization development, construction units should reasonably pay close attention to and fully explore this construction technology, in order to comprehensively improve the application level of transportation technology in the engineering construction process. In response to this issue, a large number of researchers have pointed out that construction units should reasonably control the application of prestressed technology from multiple perspectives such as personnel, technology, system, and supervision during the construction period, in order to effectively ensure the reasonable improvement of the application effect of transportation force technology, and then achieve comprehensive improvement of the comprehensive performance of highway and bridge engineering in China, promoting the rational utilization of its transportation application value, To lay a solid foundation and guarantee for the full satisfaction of the daily needs of the people. Digital protection has gradually become one of the main ways of cultural heritage protection in today's society. These technologies can be used to improve the accuracy and integrity of digital protection. This paper expounds the basic logic and concept of digital protection of Yuling art resources by using digital art theory, analyzes and applies the protection problems existing in the existing stone carving art and ancient buildings during the investigation, and there is a gap in online digital protection, so it uses digital technology to develop the art resources of Yuling. Through digital photography, panoramic video, data collection, 3D modeling, virtual display and other methods, yuling art resources are recorded and displayed in a more comprehensive and vivid way, free from geographical restrictions, realizing resource sharing, and truly becoming a cultural heritage that all mankind can "own".

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