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Analysis on Effectiveness of Testing and Evaluation of Bridge Repair and Reinforcement

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Abstract: Bridge engineering is an important part of basic engineering in today's transportation field, and its quality and performance have a vital impact on the improvement and development of modern transportation engineering. With the continuous development of transportation engineering, the maintenance and reinforcement of existing bridges are also being given more emphasis. In order to scientifically evaluate the effectiveness of bridge maintenance and reinforcement, this paper analyzes its detection and evaluation, including the significance, key points, and main methods of detection and evaluation. Therefore, this analysis aim to provide some reference for the maintenance and reinforcement and the quality improvement of bridge engineering.

Keywords: Bridge engineering; Maintenance and reinforcement; Testing and evaluation method

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1. Introduction

The objectives and the important points needs to be outlined for the inspection and evaluation of the maintenance and reinforcement effect of bridge engineering. Then, based on the outline while considering the characteristics of the project or bridge itself, a reasonable method is adopted to detect and evaluate the effectiveness of its maintenance and reinforcement. Only in this way can the effect of maintenance and reinforcement of bridge engineering be well guaranteed, the application quality and safety of existing bridges can be improved to the greatest extent, and the coordinated development of existing bridge engineering and modern transportation industry can be promoted.

2. Overview of effectiveness of current testing and evaluation methods

2.1. Significance of testing and evaluation

With the development of the social economy and transportation engineering, the original structures of many existing bridge projects are gradually unable to meet the actual transportation needs. Under such circumstances, the relevant units need to carry out proper maintenance and reinforcement of the existing bridge project, so as to improve its safety and reliability, and prolong the service life of the existing bridge. However, if the effect of the corresponding maintenance and reinforcement work is not tested and evaluated properly, there will be hidden risks in the existing bridge structure, thereby affecting its subsequent application effect, and in severe cases, it may even lead to major safety accidents, posing a greater threat to the quality and safety of transportation [1]. Therefore, reasonable measures need to be taken to test and evaluate the condition of the repaired and reinforced bridge, so that problems can be detected and rectified in time. This is very important for the quality assurance of bridge engineering maintenance and

reinforcement and the improvement of safety.

2.2. Key points of testing and evaluation

For the repaired and strengthened bridge project, relevant units and staff should pay attention to the following key points when performing inspection and evaluation of repair: firstly, on-site investigation needs to be done, including on-site geological conditions, environmental conditions, and traffic load, and many more, so as to clarify the actual operation and maintenance status and requirements of the bridge project. Secondly, the original design and repair and reinforcement design drawings of the bridge project needs to be fully understood, and the key repair parts need to be identified. The third step is to choose a reasonable detection and evaluation method depending on the repair and reinforcement methods and the situation on-site. In this way, not only can the evaluation be performed more efficiently, but the evaluation results will also be more accurate, thus laying a good foundation for the improvement of bridge engineering quality and safety.

3. Effectiveness testing and evaluation methods of bridge maintenance and reinforcement

3.1. Testing and evaluation of seal grout

Seal grout is a commonly used technology in the repair and reinforcement of bridge engineering. The effect of the treatment is then evaluated. (1) The relevant information of seal grout is collected and the inspection records are filled in on the spot to ensure the integrity and traceability of all information. (2) A good distinction needs to be made between potting and seam sealing. A column should be dedicated to each component of the inspection for data record. (3) A visual inspection of each colloid should be carried out in the repair and reinforcement of bridges. (4) During the inspection process, the specific scope where a problem is discovered and the date of discovery should be marked with a marker pen, and its development should be continuously observed in the follow-up inspection. As for typical issues found in the inspection, it is necessary to take pictures and save them, and put them in the records. (5) For bridge components with a long construction period and relatively high seam sealing efficiency, there is a need to confirm whether there is any plans for re-construction in the near future. (6) The surrounding environment of the bridge project needs to be well analyzed, including conditions such as direct sunlight and water damage. If water damage is found in the repaired and reinforced position, it is necessary to focus on its outer structure and observe whether there is any water leakage [2]. Through the method above, the effect of the bridge seal grout can be effectively tested and evaluated. Hence, corresponding problems can be found and dealt with in time.

3.2. Testing and evaluation of the effectiveness of steel plate reinforcement

Steel plate paste is an effective method in the repair and reinforcement of existing bridges. The effect of this treatment can be evaluated through a few steps. (1) Collect all relevant information of the steel plates and accurately record the various inspection contents after the steel plate is pasted and strengthened, and confirm the specific processing time, steel plate material, steel plate thickness, and manufacturer and other information [3]. (2) The steel plates are observed; its geometric dimensions are measured along the edge of the steel plate with a steel tape, and its length, width and actual pasting direction are recorded; position and area any hollow in the steel plate by are detected by tapping, and make a mark with a marker pen good record. (3) For some typical issues found in the inspection, photos should be taken and saved for future processes [4]. (4) The steel plates, bolts and other materials are observed, and the degree of corrosion is determined according to their appearance [5]. (5) The number of bolts used in the pasting of steel plates per square meter are calculated on site, one of the steel plates is used as the sample in which its reflection and water stains are observed and recorded (6) The effect of the steel plate is evaluated through a comprehensive calculation of the total number of steel plates, the weight of a single steel plate, the load of the bridge

structure, and the performance parameters of the bolts. In this way, the defects or problems existing in the steel plate paste treatment can be discovered in time and a treatment plan can be formulated accordingly, so as to ensure the good effect steel plate paste reinforcement technology in the bridge repair and reinforcement treatment [6].

3.3. Testing and evaluation of the effectiveness pf carbon fiber cloth paste reinforcement

Carbon fiber cloth is a new type of material widely used in the repair and reinforcement of bridge engineering. After the carbon fiber cloth is pasted and reinforced, in order to scientifically tested and evaluated. (1) All processing and construction data are collected, including pasting time, carbon fiber cloth manufacturers, technical units, so as to lay a good foundation for subsequent testing and evaluation work [7]. (2) The appearance and bonding effect of carbon fiber cloth are observed. Carbon fiber cloth with poor appearance quality or is weakly bonded should be marked with a marker pen on site, and corresponding inspections should be made, including specific quality problems, testing date, and testing personnel, etc., in order to provide sufficient basis for the follow-up processing work. (3) For some typical carbon fiber cloth pasting issues, the staff should take pictures and save them, so as to provide reference for subsequent engineering inspection, evaluation and problem solving. (4) If the surface of the carbon fiber cloth falls off during the inspection, that particular area needs to be measured along the edge of the with a steel tape, which will be used as a basis for the calculation of the surface disconnection rate of the carbon fiber cloth [8]. In this way, it is possible to determine the treatment method for the detachment of the cloth, and to make a scientific evaluation of its effectiveness, so as to provide a strong reference for its subsequent further processing and maintenance, and maximize the effectiveness of carbon fiber cloth repair and reinforcement in bridge engineering [9].

3.4. Testing and evaluation of effectiveness of prestressed steel strand repair and reinforcement

Prestressed steel strands are also commonly applied to the outside of the structure in bridge repair and reinforcement treatment, which is carried out in a few steps. (1) Relevant information including the time taken for this method of treatment, quality of prestressed steel strands, performance parameters, manufacturer details, construction units, are collected in order to evaluate the basic quality of the prestressed steel strand. (2) The microcosm of the steel strand is observed including the deformation of the steel strand, anchoring effect, and many more. Any problems discovered should be photographed and saved, and detailed inspection records should be made [10]. (3) The appearance of all anchor blocks, steering blocks and polyethylene (PE) sheaths are observed, and their condition should be recorded. Any problems discovered should be photographed and saved. (4) The environment of the steel strands should be evaluated by combining existing data and field investigations; the number of steel strands used in each reinforcement treatment are counted, and then the number of damaged components is determined. The number of damaged bridge components is then used as the basis to calculate the actual steel strand prestressing requirements, and finally the effectiveness of its reinforcement treatment is evaluated by comparing the actual prestressing requirements with the actual treatment conditions [11]. In this way, the quality of the prestressed steel strand and also its effectiveness in bridge repair and reinforcement can be evaluated, which will be helpful for the operation and maintenance of the bridge.

4. Conclusion:

In conclusion, due to the continuous increase of traffic load and various external factors, the quality and performance of many bridge structures will continue to decrease. To effectively ensure the application effect of bridge engineering and meet the quality and safety requirements of modern transportation engineering for bridges, suitable technical measures need to be taken to repair and strengthen existing

bridges. Besides, reasonable measures also need to be taken to test and evaluate the effect of repair and reinforcement, such as testing and evaluating the treatment effect of seal grout, steel plate pasting, carbon fiber cloth pasting, prestressed steel strand, and many more. In this way, problems in the repair and reinforcement of bridge engineering can be discovered and dealt with in a targeted manner.

Disclosure statement

The authors declare no conflict of interest.

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