Load of Reinforced Concrete Composite Bridges

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Abstract. At present, the proportion of bridge construction in China is increasing, especially in recent years with the continuous improvement of construction technology, more and more difficult bridge construction success, a variety of cross-sea Bridges are also rising rapidly. The traditional bridge structure is mainly steel structure, which has high strength, plasticity and toughness. However, the stability of the bridge will be more or less affected when the steel reinforcement is subjected to tension, which is not conducive to ensuring the safety and stability of the bridge. With the continuous improvement of technology, the comprehensive application of concrete and steel is gradually applied in belt bridge construction, and composite bridge has gradually become the main form of bridge construction. The purpose of this paper is to realize the safety construction of composite Bridges by studying the load of reinforced concrete composite Bridges. This paper first gives an overview of the reinforced concrete composite Bridges, and then with the help of section stress calculation, carries out a detailed analysis of the load situation of composite Bridges, and on this basis, realizes the continuous improvement of composite Bridges construction level. The experiments in this paper show that the composite bridge structure is in a safe and stable state, and its safety coefficient is higher than that of the non-composite bridge.

Keywords: Reinforced Concrete, Composite Bridge, Load Test, Section Stress Calculation

1. Introduction

The traditional bridge construction is dominated by steel Bridges, which are strong in strength and have strong plasticity and toughness, but the steel reinforcement itself also has certain limitations. When the steel reinforcement is subjected to strong tension, its stability will also be affected, shortening the service life of the bridge, and bringing adverse impact on the safety of the bridge. At present, with the continuous improvement of safety requirements for bridge construction, the construction of reinforced concrete composite Bridges gradually occupies a dominant position. However, the concrete load analysis of reinforced concrete composite Bridges is not enough, which affects the further construction of reinforced concrete composite Bridges. Therefore, it is particularly important to analyze and study the load conditions of reinforced concrete composite Bridges.

Reinforced concrete composite Bridges started relatively late, probably at the beginning of the last
century. The structure of this composite bridge realizes the complementary advantages of steel reinforcement and concrete construction materials, giving play to both the tensile characteristics of steel reinforcement and the compressive characteristics of concrete, ensuring the stability and safety of the bridge to the maximum extent [1-2]. At present, scholars at home and abroad have conducted a series of researches on reinforced concrete composite Bridges. The construction of reinforced steel Bridges and composite Bridges started late in foreign countries, and there are still many deficiencies compared with foreign countries [3-4]. Through consulting relevant materials, it can be found that current researches mainly focus on single bridge structure, construction mode of composite Bridges and stress analysis of composite Bridges, while few researches focus on load research of reinforced concrete composite Bridges [5]. Therefore, in this respect, there is still a big theoretical gap in this study, which needs to be further improved.

In order to make up for the lack of research on the load of reinforced concrete composite Bridges in China and realize the scientific construction of composite Bridges, the purpose of this paper is to realize the safe construction of composite Bridges by studying the load of reinforced concrete composite Bridges [6-7]. This article first has carried on the outline of reinforced concrete composite Bridges, then with the aid of the stress calculation, and in accordance with the loading experiment of reinforced concrete composite Bridges for composite Bridges were under the condition of different load cases in detail the specific analysis, get the combination bridge load value, on the basis of the realization of combination to improve the level of bridge construction [8-9]. Through a series of studies, the scientific analysis of the load status of composite Bridges is realized, which is conducive to further improving the safety of composite Bridges. On the one hand, it promotes the research of reinforced concrete composite bridge load and improves the relevant theories. On the other hand, it provides a theoretical basis for future relevant studies [10-11].

2. Method

2.1 Overview of Reinforced Concrete Composite Bridges

The reinforced concrete composite bridge has realized the effective combination of the advantages of reinforcement and concrete. Steel bars are used in the tension zone of the bridge, while concrete is used in the compression zone of the bridge. With the help of shear joints, the bridge is integrated into a whole, and the building forms a composite bridge. Combined Bridges realize the dual advantages of steel bar and concrete, make up for their respective shortcomings in bridge construction, and reduce the occurrence of various adverse phenomena such as poor compression stability of steel bar cracked by tension in concrete [12-13]. The common composite bridge structure under reinforced concrete is composite arch bridge, composite steel plate bridge and hybrid bridge. The connection modes of reinforcement and concrete are also varied. The common connection modes are cementation type, bonding type and joint type. The selection of connection modes should be based on the actual situation of bridge construction. Compared with non-composite Bridges, under the same load pressure, the maximum stress and vertical displacement of reinforced concrete composite Bridges are smaller than that of non-composite Bridges, and the strength and stiffness of reinforced concrete composite Bridges are far higher than that of non-composite Bridges [14-15]. The research on the load of reinforced concrete composite Bridges can realize the concrete analysis of the load of composite Bridges and improve the performance of reinforced concrete composite Bridges.

2.2 Calculation of Section Stress

Section stress calculation refers to the stress analysis and calculation of a section of composite bridge, which can analyze the stress of different parts of composite bridge, so as to realize the in-depth analysis of composite bridge load. In order to accurately calculate the section stress of composite Bridges, finite element analysis must be carried out first. Finite element analysis can be used to analyze the overall structure of Bridges, especially the main girder structure. The specific calculation
formula is as follows:

$$Z = \left( \frac{1}{2a} \right)^3 \frac{I_{Q1}}{I}, I_{Q1} = \beta Q_0$$ (1)

Where, $l$ mainly represents the main beam length of composite bridge; $A$ represents the distance between different main beams; $I$ and $I_{Q1}$ represent the rectangular inertia between the beam and the main beam, respectively. $I_{Q1}$ mainly represents the stiffness of a single bridge beam and column; Coefficient of correction. Then, on the basis of finite element analysis, the main accurate data of composite bridge are obtained, and then the section stress of composite bridge is calculated accurately. The specific calculation method is as follows:

$$N = \frac{Ac}{nAs + Ac} d$$ (2)

Where, $N$ represents the sectional stress of the composite bridge; $Ac$ and as respectively represent the cross-sectional area between the steel beam and the bridge plate, and $d$ represents the distance between the steel beam and the bridge plate. It is necessary to pay attention to the influence of various factors such as temperature and shrinkage on the section stress.

3. Load Test of Reinforced Concrete Composite Bridges

Determination of experimental contents and instruments. This paper selects A reinforced concrete composite bridge as the main experimental object. The load test mainly measures the stress, deflection and overall stress characteristics (natural vibration frequency, damping ratio and impact coefficient) of the bridge under normal operation. The instrument for strain measurement is a vibrating string surface strain gauge. The test range is (-1000-15) µε, with an accuracy of 0.4 µε. The deflection measuring instrument is a digital displacement meter; Firstly, the vibration velocity of the bridge is measured by means of piezoelectric acceleration sensor, and then the specific value of the vibration velocity is obtained by means of integral calculation. The first is the determination of load test point; The load points of reinforced concrete composite Bridges mainly include 62 strain section test points, 18 deflection section test points and 4 dynamic load test points. Carrying out load experiment on three measuring points can realize the comprehensive test of composite bridge. Secondly, the working condition test of reinforced concrete composite bridge; In order to fully grasp the bearing capacity of composite bridge under different conditions, it is necessary to test the load of composite bridge under different conditions. It mainly includes two conditions: static load test condition and dynamic load test condition.

4. Discuss

4.1 Analysis of Deflection Deformation Test Results

In the deflection deformation experiment test in this paper, a total of 8 loads were carried out, with an average of 2 loads for each dynamic and static working condition. The actual measured value of deflection is the average of the deflection measured results obtained under 2 different loads. The actual measured values of different deflection measurement points and the calculated results of different deflection under the action of experimental load are shown in table 1 below. The data in the table are the results of the author's experimental arrangement.

Through consulting relevant data, we find that the deflection calibration coefficient between 0.5 and 0.8 indicates that the overall structure of the bridge is of good toughness and good mechanical condition. According to the data in table 1, we can find that the actual measured calibration coefficient is between 0.5-0.8, which indicates that the structural toughness of A reinforced concrete composite bridge is relatively strong and the overall stress condition of the bridge is relatively good.
4.2 Analysis of Stress Test Results

In the stress test experiment in this paper, a total of 8 loads were carried out, with an average of 2 loads for each dynamic and static condition. The actual value of the stress test is the average value of the stress measurement results obtained under 2 different loads. Through consulting the data, it is found that the stress status of composite Bridges under different mechanical parameters also has certain influence. The specific stress measurement results at the stress measurement points under different mechanical parameters are shown in figure 1. The data in the figure is the results of the author's experimental arrangement.

![Figure 1. Stress analysis of composite Bridges under different stress parameters](image)

It can be seen from figure 1 that the change of mechanical characteristic parameter G will have a certain impact on the stress analysis results, but the impact is relatively small. Since the change of G has little impact on stress analysis, it is often ignored by people, thus affecting the scientificity and accuracy of stress analysis results and causing calculation errors. Therefore, it is necessary to pay attention to this problem in order to get accurate composite bridge stress results.

4.3 Experimental Measurement Results of Dynamic Load

In the dynamic load test measurement of composite Bridges, different methods are used to stimulate composite Bridges, mainly by the following two methods. The other is the brake experiment of the car on the composite bridge. During the experiment, the vibration of the bridge is measured by the sensor, and the damping ratio reflecting the dynamic load is obtained. Through the test, the damping value of the composite bridge is 0.0226, which indicates that the composite bridge structure can remain stable and complete under the condition of dynamic vehicle passage.

5. Conclusion
Compared with the non-composite bridge, the reinforced concrete composite beam fully realizes the combination of the advantages of the reinforced steel and the concrete, reflects the better mechanical properties, not only makes up for the shortcomings of the two materials in the bridge construction. At the same time, under the influence of shear joints, the probability of the concrete and concrete slipping is gradually reduced. In this case, the steel and concrete are considered as a whole stressed structure, which greatly improves the stiffness and strength of the composite bridge and ensures the safety and stability of the bridge.

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