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# Research on Corrosion Detection and Assessment Method for Hydraulic Concrete Structures

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**Abstract.** In our country, hydraulic concrete structure construction technology is widely used. However, with the increase of time and the erosion of the environment, there will be aging and safety risks in this structure. This puts forward higher requirements for detection technology and safety assessment technology of hydraulic concrete structures. Therefore, in order to promote the innovation and progress of this engineering technology, we should carry out targeted strategy analysis based on the development and application status of related technologies and engineering practice. We should also actively introduce advanced detection technology and equipment to maintain the development of China's hydraulic concrete structure construction technology. This is conducive to the vigorous and healthy development of China's water conservancy projects.

**keywords:** structural concrete; structure; corrosion detection; evaluation; research strategy.

## 1. Introduction

We should inspect and evaluate every link of the actual construction process. Because of the complexity and diversity of the construction environment, we should adjust the safety assessment in time according to the changes of the actual geographical conditions, construction materials, construction technology and so on. At present, the most concerned problems are concrete strength, internal defects, deep cracks, weathering corrosion and so on. If we want to test and evaluate the durability of structures, we should also consider the problem of structural corrosion. Only in this way can we strengthen the inspection and evaluation from inside to outside, so as to ensure the stability and safety of hydraulic concrete structures.

## 2. Analysis and Detection of Corrosion in Concrete Dams

In our country, the environment of hydraulic concrete structures is usually complex, and the corrosion of dam structures will occur, which will greatly affect the integrity of the building structure, reduce the service life of concrete dams, and even cause leakage and cracks. Therefore, in the field of hydraulic concrete construction, great attention will be paid to the weathering and corrosion problems of dams. According to the actual situation, timely detection construction is carried out to detect the distribution, depth and other corrosion. However, due to the limitation of the detection construction environment and the limitation of existing equipment and technology, the detection of dam corrosion brings a great test.



Nowadays, the corrosion of concrete structures in our country mainly includes electrochemical corrosion, hydrogen evolution corrosion, chloride salt corrosion, carbonization corrosion, etc. The corrosion detection methods mainly use high density electrical method and electrified rapid corrosion test. This method is widely used at home and abroad, and can be more effective in engineering detection. The high-density electrical method first analyses the whole dam body and takes samples. In this paper, the sampling process is as scientific and reasonable as possible and representative, but due to the limitation of sampling conditions, there are some defects in the point-to-area sampling method. Then the experimental data are used to further deduce, and the corresponding engineering conclusions are obtained. This method has little damage to the dam body of concrete structure, so it can be improved and applied. The method of rapid corrosion by electricity can also effectively avoid damage to concrete dam body. While saving manpower and material resources, it not only shortens the construction period, but also greatly reduces the impact on concrete structure. The disadvantage is that it is easy to be affected by other fillers in dam body, dry and wet environment and other factors. There are many problems in stability, which will affect the test results of the project to a certain extent. Therefore, at present, it is impossible to directly use this non-destructive testing method to carry out construction Detection Based on the method of rapid corrosion through electricity. It needs to be organically combined with other construction schemes and cooperated with each other. Under the new situation and paying attention to sustainable development strategy, non-destructive testing technology and equipment are being vigorously developed in the field of hydraulic concrete construction detection. It is hoped that in the future engineering detection process, based on the integrity of the original concrete dam body, the corrosion detection and dam body evaluation can be completed quickly, so as to promote the rapid development of concrete dam body in China.

Under the new situation, under the severe pressure of engineering testing demand, researchers actively introduce technology in other scientific and technological fields and set up a new comprehensive technology for corrosion detection of concrete structures. For example, introducing sound wave and electromagnetic technology instead of enriching the original detection system can effectively solve the impact of other fillers, temperature, dry humidity and other factors on the detection, using the beam. Turning and focusing to obtain the beam scanning image can improve the detection accuracy and enhance the feasibility of engineering detection to a certain extent. Electromagnetic technology uses elastic wave to get detection data. However, limited by the development of technology research, these advanced technologies still need further improvement to improve stability. Therefore, our country is committed to maintaining the safety and stability of buildings, prolonging the structural life of buildings and promoting the rapid development of this field.

### **3. Inspection of internal corrosion and strength of hydraulic concrete structures**

Corrosion of concrete structure has a great influence on concrete strength detection and internal quality of hydraulic concrete dam body. Generally, drilling core-collecting method is adopted, but this method mainly sampled the point area of dam body, which cannot guarantee the representativeness of samples with high quality. In addition, the amount of core-collecting needs to be controlled to avoid damage to dam body of concrete structure. Core samples are tested for corrosion resistance, compression resistance, tension resistance and so on. Corresponding test data are obtained, and then further analysis is carried out. Solutions such as reinforcement are formulated in time to maintain the safety and stability of concrete structure dam body and prolong its service life.

With the development of corresponding detection technology for hydraulic concrete structures, advanced scientific research achievements in other fields have also been introduced into the detection technology system. To cite several typical examples, recently, some researchers have used shear wave reflection to monitor the corrosion of cement mortar, and used shock echo to study the short-term strength of concrete affected by corrosion, etc. In a series of technological innovations, the relevant experiments of water-cement ratio are more conspicuous, which is helpful to study the effect of water-cement ratio on the curing age of concrete structure dam body. Water-cement ratio affects the corrosion resistance of concrete structure to a certain extent. According to the relationship between concrete

strength and wave velocity, the experimental basis is provided. Based on this research method, the corresponding mathematical model can be established, which is helpful to engineering. The prediction of corrosion rate of concrete structure lays a firm foundation for quality inspection of hydraulic concrete structure dam. The impact echo testing method is mainly used to evaluate the viscous strength of reinforced concrete and its interface, which is helpful to control the corrosion situation. Using load test to determine the bond strength can effectively and quantitatively detect the bond strength and clarify the corrosion situation between reinforced concrete and its interface. This method can also be used to test the quality of pre-stressed tunnel grouting, but the impact-echo method is not suitable for the detection of mass concrete structures, so the detection of concrete dam body is limited, and needs to be improved and improved.

Some foreign researchers introduce radar electromagnetic means to carry out innovative engineering detection, for example, ground penetrating radar CT detection method, using the reflection of high-frequency electromagnetic wave of detection radar to understand the underground structure and geological corrosion. At present, the method is still in the experimental research stage, and has not been widely promoted. According to the practical research, the ground penetrating radar (GPR) attenuates the high frequency electromagnetic wave rapidly in the course of propagation due to the influence of water content in the medium, which limits the detection range and affects the detection effect. Therefore, it is necessary to upgrade the detection equipment of geological radar, enhance the intensity of signal source, optimize the mode of transmission, minimize the impact of external environment, and make the attenuation rate too fast. In addition, attention should be paid to the choice of use environment and detection direction, because the attenuation of detection radar electromagnetic wave is not only related to medium and water content, but also affected by internal structure and material composition. But in general, this method can effectively reduce the damage to dam body caused by detection. Enhance the research of detection, actively introduce advanced detection technology and equipment from abroad, innovate detection system, improve construction process, and escort the detection and evaluation of corrosion of hydraulic concrete structures in China.

#### **4. Assessment of Safety Impact of Corrosion of Reinforced Concrete Structures**

Corrosion and damage of hydraulic concrete structures is a major problem in China. At present, on the basis of vigorous construction of hydraulic concrete structures, our country strengthens the maintenance and improvement of the original buildings, and further alleviates the potential safety hazards caused by aging and corrosion. This also makes the detection and evaluation technology of hydraulic concrete structure become a hot research topic. Usually, safety assessment includes two parts: one is safety assessment, that is, safety assessment of load intensity of concrete structure, the other is durability assessment, which is mainly aimed at atmospheric effect, chemical erosion and wear of concrete structure buildings in the environment. Resistance capacity and actual bearing capacity of original shape, quality and function are closely related to the service life of buildings. However, due to the complex and changeable factors, the research progress of this work is slow and it is difficult to achieve innovative results. It can be seen from the above that it is very necessary to carry out safety assessment of concrete structure buildings. Therefore, even though there are many difficulties, it is necessary to strengthen research, actively innovate, construct a new detection and evaluation system, improve the construction process, and promote the development of engineering transformation and maintenance.

Not only does our country attach great importance to the research and development of detection and evaluation technology, but also many research results have been recognized internationally, which provides a new direction for the future development of detection and evaluation work. For example, the use of non-linear finite element analysis method to grasp the reinforced concrete structure; based on concrete carbonization, chloride ion component analysis of its service life; steel and concrete bond strength and degradation research. Advanced computer network technology is used to strengthen the establishment of mathematical models, enrich research means, and provide a strong theoretical basis for practical construction.

Hydraulic concrete structures are usually large in size, diverse in environment and variable in stress conditions. Therefore, in order to effectively carry out safety assessment and analysis, the effective element method will be used to establish corresponding models according to the reinforcement in different situations, mainly separated, combined and integral. Firstly, the separated type regards steel bar and concrete as two different research objects, and then simulates and analyses the bond between them. However, because the detection is affected by the concrete distribution and direction of steel bar, the calculation is limited and difficult to achieve. The combination model regards the two as a whole while the integral model regards the reinforced concrete as homogeneous material. According to the proportion of the two, it is projected in the stiffness matrix, which greatly reduces the amount of calculation. It is conducive to the safety assessment of reinforced concrete structures.

In addition, the service life assessment in durability assessment is also very important. According to the actual damage situation of the structure, aging factors, aging rate and so on, quantitative analysis is helpful for further analysis. The main factors restricting the service life of reinforced concrete structures are chloride ion erosion, carbonization, load, cracks, leakage and so on. The situation is complex. In most cases, they act together and interact with each other. Therefore, the main evaluation methods are empirical estimation, accelerated experiment, mathematical modeling, computer simulation and so on, which can achieve the life prediction of reinforced concrete structures to a certain extent. In order to better evaluate the safety of hydraulic concrete structures, it is necessary to summarize and sort out the past evaluation data and experience, quantitatively analyze the related data, and draw empirical conclusions, so as to provide a solid theoretical technology for future safety evaluation construction, save manpower and material resources, and select assessment treatment scheme more quickly. In addition, it should be noted that the safety assessment of concrete dams is different from that of reinforced concrete structures, and is not affected by reinforcement corrosion and carbonization. It is mainly affected by the strength of materials themselves, changes in osmotic pressure, changes in external environment, earthquakes and so on. There are more and more influencing factors. Therefore, China has vigorously developed research and development of technology and equipment in this field. Recently, China has made independent innovations. At the forefront of world technology, vigorously promote the development of safety detection and evaluation of hydraulic concrete structures in China.

## 5. Conclusion

Since the reform and opening up, China has vigorously built hydraulic concrete structure construction facilities. In order to conform to the concept of sustainable development, we should not only promote the construction, but also pay attention to the maintenance and renovation of the original buildings, and strengthen the safety detection and evaluation of the corrosion of hydraulic concrete structures. Therefore, we must devote ourselves to the improvement and innovation of technology, actively introduce advanced technology in other fields, enrich the means of detection, and optimize the evaluation files. Attaching importance to engineering practice and seeking truth from facts will contribute to the development of engineering construction in China.

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