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Review Article

Research on damage diagnosis for civil engineering structures

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Abstract: In the construction of such an important basic engineering project as civil engineering, the main problem faced by constructors is the structural system damage. Therefore, scientific diagnostic methods are needed to find out locations and causes of the damages in time. For this reason, people have carried out in-depth analysis according to the system form and composition mode of civil structure, and have developed a variety of scientific and reliable diagnostic methods combined with its related damage problems. With the rapid development of diagnostic technology, inspectors have a clearer understanding and knowledge of all kinds of damage problems, and can also use a variety of diagnostic methods reasonably to find out.

Keywords: Civil engineering; damage; diagnostic method

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1. Introduction

As an important foundation of construction, civil engineering projects will threaten the safety of the whole building if there are any damages and hidden dangers in civil structures. Therefore, these problems inside the structure must be found timely and accurately during the construction, and thus they can be controlled in time and the earliest. What is more important is to use diagnostic methods reasonably to detect these problems and analyze the causes. Currently, there are many advanced methods for the inspectors to choose in civil structure damage diagnosis work. Inspectors should scientifically choose the most appropriate diagnostic technology method based on the specific characteristic of each problem.

2. Main diagnostic technical methods for civil structural damage

2.1 Specific frequency variation

In the damage identification and diagnosis of civil structures, models are used to simulate various indexes and parameters of their structural systems. In a large amount of parameter data, natural and specific frequencies are easily obtained. This frequency variation is a parameter that the inspectors pay close attention to. If there is damage problem in a structure itself, then measured frequency value will shows irregular or abnormal reflection when detecting its internal structure. At this time, the specific location of the damage problem can be determined depending on the measured range of abnormal frequency change, thus achieving the goal of diagnosis.

2.2 Changes in vibration morphology

Under the condition of changes in vibration morphology, it is an important applied technical method for diagnosis and detection to analyze the problem of civil structural damage by comparing the morphology before and after changes. It can be found

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that many diagnostic techniques and detection methods rely on finding some abnormal changes in frequency and vibration amplitude to accurately obtain damage information. The change of vibration mode has also been captured by the detection personnel and has become a very important diagnostic technique. It mainly includes curvature mode and pattern change mode, both of which can make clear diagnosis for damage problem.

2.3 Compliance index detection

The main structure of civil engineering construction itself needs to have strong bearing capacity and strength, so as to ensure the safety of the building. However, once the structural damage problem occurs, the strength of some or local links will obviously decrease, which involves the important parameter of compliance index. It is the structural damage that causes the compliance index to change. The diagnosis and detection staff can use the change to analyze the severity of the damage problem, and also accurately determine the scope and specific orientation of the damage problem.

2.4 Stiffness index detection

During the structural damage detection and diagnosis of civil engineering, the change of stiffness index can be found through diagnosis. This index parameter can provide more abundant damage information. once the damage problem is too serious, the stiffness index will change greatly, which is greatly different from the stiffness index requirement in the design scheme. Finding the node with its change in the detection process can clearly identify the specific location of the damage problem. However, the method should be carefully selected when the problem is relatively minor.

2.5 Neural network diagnosis

Artificial Neural Networks is a simplified system that simulates the processing mode, organizational structure and system functions of biological neural systems. A large number of neural processing units form a complex artificial neural network. It can store the relationship between input and output results without relying on models and only learning data in the processing process. It has strong nonlinear amplification capability. Different neural networks creates complicated approximate mapping models, which are extremely compatible in nonlinear diagnosis.

3. Development of structures damage diagnosis in civil engineering

Through the study of structural damage diagnosis methods, small damage diagnosis, compared with large damage, is easier to judge and more optional for judgment methods. Due to less influence, small damage is difficult to diagnose accurately. However, the vast majority of large damages are developed from small damages, so it is very important to accurately judge small damages, which is of great significance to ensure structural safety. It can be seen that although the diagnosis of minor injury is difficult and will be affected by external factors, it will have a great impact on local parameters. Therefore, the diagnosis of minor injury has high research value. Multidisciplinary Intersection and Diagnosis: For different large-scale complex structures, they are not only distinctive in characteristics, but also have significant differences. They include a variety of disciplinary knowledge, such as mechanical engineering, construction engineering and material engineering. A single dynamic diagnosis method is difficult to achieve the damage assessment objectives of complex structures. Based on this, it is one of the main development trends in the future to deeply discuss the damage diagnosis and integrate multi-disciplinary technologies to complete the diagnosis. Among them, multi-disciplinary refers to vibration theory, signal processing, pattern recognition, artificial intelligence and material structure, *etc.* On-line Diagnosis of Structural Damage. Most of the current structural damage diagnosis is carried out after the occurrence of definite actual influence, and damage information cannot be grasped at the first time. In order to improve and ensure structural safety, a complete on-line diagnosis system is needed. On-line diagnosis has high real-time, continuity and predictability, can provide more favorable conditions for damage treatment, and has great research value and development prospect.

3.1 Model Correction Technology

The model correction technology mainly adopts the method of dynamic correction, and integrates static data and dynamic data with multiple data testing methods to ensure that the measured data results can be compared with the original data results. In this process, the modified model can be analyzed with the help of corresponding index technology, and the mechanical parameters measured in the testing process can be analyzed with the structural testing method, and compared with the accurate data model to analyze whether the parameter structure meets the basic index requirements. Through this method, the calibration efficiency of dynamic and static tests can be improved, and the model correction and diagnosis results can be unified. Using the model test method of structural damage for analysis can ensure that all kinds of damage conditions and their parameter effects are controlled within the rated indexes, so that the standard control mechanism is unified with the test results. This kind of model needs to test the structure of the model by means of model establishment and data analysis. By measuring the safety parameters of pipe fittings, a reasonable damage parameter value can be obtained to provide calibration support for staff. In the actual test, the staff need to use the corresponding software to analyze various stress conditions and combine with the corresponding mathematical model to obtain a more accurate test result, so as to ensure that all test requirements meet the test requirements of the model.

3.2 Local testing technology

Local testing mainly adopts the concept of non-destructive testing, and studies the working conditions and stress of equipment in a specific area to ensure that all kinds of testing requirements meet the specified requirements. This technology mainly adopts the concept of non-destructive testing. The main testing direction is the defect situation in a certain area of the project, and the equipment function in this area is analyzed. Its testing methods include ultrasonic testing and radiographic testing technology. Through the use of various test models for calibration and analysis, and by means of the space conditions of pipe fittings, the connection conditions of main components are ensured to meet the test requirements and achieve the stable purpose. At the same time, the crack condition of local pipe fittings is also the focus of damage testing. Its testing goal is to analyze the connection function between pipe fittings, obtain an accurate result through reasonable testing requirements, and ensure that all testing requirements can meet the actual situation. In addition, the test should be carried out in combination with multiple test requirements and test objectives, and the compatibility between various test results should be analyzed by corresponding control forms. For example, in the radiographic testing, the connection function between each pipe fitting is mainly tested by infrared transmission, and the verticality of the component is analyzed by combining the corresponding light path trend.

3.3 Fingerprint test technology

Fingerprint testing technology mainly adopts the concept of dynamic monitoring, and presents relevant test data in the test interface. Among them, the test data mainly includes dynamic functions such as biological frequency, biological amplitude effect, building structure strain situation, MAC parameter value. In this process, the staff should adopt the test requirements of biological fingerprints, check all the test results, and compare and sort out all the test results in combination with the corresponding standard test values to make all the test contents meet the actual requirements. Some test results are rather complicated, so it is necessary to analyze the test results in combination with the system test requirements, so as to improve the accuracy of damage test. In a word, in the actual testing process, the biological testing principle should be adopted to summarize the tested data, and focus on testing the parts where hidden works may be damaged, so as to sort out the corresponding testing results. However, this test cannot comprehensively test the damage of pipe fittings, and comprehensive analysis should be carried out in combination with local testing concepts. Through nondestructive testing of a certain position, a more accurate test value can be obtained. Staff should set up dynamic testing parameters or testing points according to the testing targets, improve the accuracy of all testing contents by improving the corresponding testing mechanism and combining with the automatic monitoring requirements, and comprehensively display the potential safety hazards of testing. Structural damage

diagnosis and identification is conducive to quickly judging the functional conditions of materials and pipe fittings. Therefore, inspectors must ensure the accuracy of test data and adopt corresponding test formulas for comprehensive design to effectively control engineering damage.

4. Conclusion

The continuous innovation and development of diagnostic techniques are closely related to all kinds of advanced science and technology. At present, in the process of civil engineering construction and construction, it is likely to encounter some structural damages and hidden problems that are difficult to find with naked eyes. It is difficult to find hidden damage problems in structures by means of manual inspection and panel inspection, and it is necessary to adopt more advanced detection and diagnostic techniques to find hidden problems at this time. This paper mainly introduces various available diagnostic techniques, each of which has its own pertinence and can solve different damage problems, which requires the inspectors to analyze the specific problems and reasonably select diagnostic methods. In the process of continuous development of diagnostic techniques and methods in the future, the application level of technology should be continuously improved to improve the technological innovation ability, so as to make scientific and reasonable diagnosis for more complex structural damages.

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