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Brief introduction of Technical Code for Monitoring of Public Building Structure

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ABSTRACT

The technical code for monitoring of public building structures is the first national specification in the domestic monitoring field of public building structures. It applies to the monitoring of engineering structures, which includes high-rise buildings and towering structures, long-span space structures, bridge structures, seismically isolated structures, and crossing constructions. Its systematic and comprehensive multi-commonly used monitoring methods are regulated and limited. The involved methods consists of strain monitoring, deformation and crack monitoring, temperature and humidity monitoring, vibration monitoring, earthquake and seismic response monitoring, wind and wind-induced response monitoring, and cable tension monitoring etc.. The implementation of this code will play an important positive role in the promotion and application of monitoring technology in the field of public buildings.

KEYWORDS: structural monitoring, Public buildings, stress monitoring, deformation monitoring, vibration monitoring

1. INTRODUCTION

In recent years, with the vigorous development of the national economy, super high-rise and high-rise structures, large span structures, bridge structures, mass concrete structures and other large engineering projects are emerging in an endless stream. They are characterized by a high level of security, large-scale construction, long construction period, complex construction process, the use of new materials and new technology, big difference in the construction phase of internal forces, deformation and design, and construction stage accidents have often occurred. The use of monitoring in these large and complex engineering structures of domestic and foreign during the construction process are effective means of solving such problems.
Structural monitoring technologies are frequent or continuous to observe or measure the state of structure and analyze early warning. By monitoring, warn hazards which may occur, and assess the structural state and safety performance of the different time periods. Structure monitoring has become an inevitable requirement to the development of structural engineering.

2. Status of the relevant codes

Currently some foreign countries and organizations have standardized on the structure

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with the monitoring system to explore, try and summarize a draft guide or promotion. In 2001, a new structure and intelligent monitoring Canadian research institutions (Intelligent Sensing for Innovative Structures, ISIS) released the "Structural Health Monitoring Guide." The guide will be regarded structural health monitoring as an important diagnostic tools, and detailed describe the structure of its various components, including: an overview of the composition of structural health monitoring, static field testing, dynamic field testing, periodic monitoring, case analysis, interpretation, and the vibration sensor and acquisition system based on damage identification algorithm. Features of the guide are rich application examples on sensor performance and damage identification method introduced in more detail.

In 2002, the international standardization organizations (ISO) released draft international norms called "dynamic tests and investigations based on the measurement results of the mechanical vibrations of bridge assessment". This norm mainly considers the purposes of dynamic monitoring, data analysis and system identification techniques, modeling and assessment of bridges. The contents of the norm include: research scope, terms and definitions, vibration testing, data analysis and structure identification methods, bridge modeling and monitoring, data evaluation and application of time-frequency analysis method and load simulation. The structure of the code is concise and the content of the code is comprehensive.

In 2002, the International Federation of concrete structures (FIB) of the Task Force issued a "monitoring and safety evaluation of existing concrete structures", the contents of the report include: monitoring and evaluation of the concept of security, structure and materials, mesh visual inspection and traditional on-site testing, nondestructive testing, measurement methods, system implementation and data collection, statistical analysis and evaluation, system analysis, monitoring and other instances. The report is well structured, more perfect. And system components, sensors and damage identification method is particularly detailed described, but only involves concrete structure.

In the same year, Intelligent Infrastructure and Transportation Security Center of Drexel University under the Federal Highway Administration (FHWA) organization completed a "paradigm important bridge health monitoring study guide", including: general, performance and health monitoring, concept of health monitoring tools and application prospects, sensors, data acquisition systems, network transmission and control, measurement verification, data management and analysis, and case studies. The research report is informative, easy to implement. But the study is only for the bridge structure and the scope of research need to be expanded.

In 2006, Structural Assessment, Monitoring and Control (SAMCO) under the EU's organization issued a "structural health monitoring guidelines F08b", aims to be the promotion and application of existing monitoring technologies. The guide includes: general principles, objectives and outline guidelines, the role of analysis, structural diagnosis, damage identification, sensor types and applications, bridge traffic load identification and partial damage identification methods. This guide introduces some special damage identification method development, but in terms of monitoring the implementation of system components and forth is not comprehensive enough.

Domestic research work on building structure monitoring technology has already begun for a long time, and achieved fruitful research results, which have been gradually recognized and used, a wide range of social benefits and substantial economic benefits

have already been accessed. A lot of large projects are installing monitoring system during construction process, such as CCTV new site office building, the Bird's Nest, Tianjin tower, Kunming new airport etc.; And there are many famous bridge, such as Tsing Ma Bridge, Kap Shui Mun Bridge, Ting Kau Bridge, Su Tong Bridge, Run yang Bridge, Nanjing Bridge, Binzhou Yellow River Highway Bridge, Harbin Songhua River bridge, Dongying, Shandong Yellow River Highway Bridge, also have been installed monitoring systems. Structure Bohai JZ20-2MUQ offshore platforms is also developed and implemented real-time security monitoring system.
Summary of the project on the basis of experience and monitoring technology on the corresponding domestic monitoring technical specifications have been put forward. Table 1 shows part of national and local regulations of the field of civil engineering in China (including subways, tunnels, dams, rock, etc.).

Table1 Part of the specification has been implemented procedures to monitor areas

Year of implementation	Norms (regulations) Name	serial number
1994	《Technical criterion on earth-rock fill dam safety monitoring》	SL-60-94
1996	《Code for monitoring of geotechnical engineering》	YS5229-96
2001	《Fundamental specification of equipment of automation system for dam safety monitoring》	SL-268-2001
2003	《Technical specification for concrete dam safety monitoring》	DL/T5178-2003
2006	《Shanghai: Specification for monitoring of foundation pit construction》	DG-TJ08-2001-2006
2007	《Technical code for monitoring measurement of subway engineering》	DB 11/490-2007
2007	《Technical code for monitoring measurement of railway tunnel》	TB 10121-2007
2008	《Specification for acceptance of dam safety monitoring system》	GB/T 22385-2008
2009	《Technical Code for Monitoring of Building Foundation Pit Engineering》	GB50497-2009
2013	《Technical code for construction process analyzing and monitoring of building engineering》	JGJ302-2013

Comparative analysis of the relevant monitoring technology standards at home and abroad, the code instructed in this paper has the following features:
First, this code is China's first national standard architectural structure of the public monitoring technology classes. In recent years, the rapid development of engineering structural monitoring technology, but has not been formally domestic national technical standards, in order to regulate and facilitate monitoring technology in the field of

engineering, this code need to be technologically advanced, economic, and properly managed and used.

Second, the broad areas are also covered in this code. This code applies to the monitoring of super high-rise and high-rise structures, large span structures, bridge structures, isolation structures and crossing construction of subway affecting the surrounding structures which are first proposed; this code is applicable to long-term, contains construction process monitoring and use period monitoring.

Third, this code gives systematic and comprehensive regulation and limitation of a variety of commonly used monitoring methods. Monitoring methods include stress and strain monitoring, deformation and fracture monitoring, vibration monitoring, wind and wind-induced response monitoring, ground vibration and seismic response monitoring, temperature and humidity monitoring, cable tension monitoring and corrosion monitoring. The problems of monitoring methods appeared in the use process have been refined and summarized, technical experience has been summarized and precipitated, and eventually forming the provisions of this code.

3. Main contents of the code

3.1 Basis and scope of the code

According to the Ministry of Housing and Urban-Rural Development "on the issuance of <2011 construction standards formulation, revision plan" notice "(Jianbiao [2011] No. 17) required by the China Academy of Building Research and Hainan Construction Engineering Co., Ltd. in conjunction with relevant units jointly developed a national standard of "public building structure monitoring technical specifications" named GB50982, structural monitoring technologies of China need to be regulated. This code applies to the monitoring of super high-rise and high-rise structures, large span structures, bridge structures, isolation structures and crossing construction structures.

3.2 Main contents of the code

This code includes eight chapters and two appendices, as follows:

1 General: describe the purpose and scope of the code and the relationship between the code and others;

2 Terms and symbols: a list of common terms defined in this code and the main common symbols explanation;

3 Basic requirements: the requirements of the monitoring purposes, monitoring content and monitoring system, the fundamental principles of measuring points and the basic requirements for equipment and other provisions are regulated; according to different time periods, divide the type of monitor into construction period monitoring and use period monitoring and specific provisions to the two stages monitoring are regulated;

4 Monitoring Methods: common monitoring methods and use scope of each method are regulated, including strain monitoring, deformation and fracture monitoring, vibration monitoring, wind and wind-induced response monitoring, ground vibration and seismic response monitoring, temperature and humidity monitoring, cable tension monitoring and corrosion monitoring;

5 Super high-rise and high-rise structures: including super high-rise and high-rise

structures , according to the characteristics of each structure, the scope of its monitoring provisions and monitoring projects, and the typical technique of construction period monitoring and use period monitoring are regulated;

6 Large span structures: including grid structures, reticulated shell structures, cable and membrane structures , large span composite structures, cantilevered steel structure and other types of large span structures, the scope of its monitoring provisions and monitoring projects, and the typical technique of construction period monitoring and use period monitoring are regulated;

7 Bridge structures: including girder bridge, cable-stayed bridge, suspension bridge, arch bridge and other types of bridges, based on the structural characteristics of different types of bridges, the scope of its monitoring provisions and monitoring projects, and the typical technique of construction period monitoring and use period monitoring are regulated;

8 Other structures: including isolation structures monitoring and the monitoring of crossing construction of subway affecting the surrounding structures; first section defines the scope of monitoring, monitoring projects and some technical points of isolation structures monitoring, the second provides monitoring programs and techniques in monitoring of crossing construction.

Appendix A: main technical indicator s of sensor device: the sensitivity, range of frequency response, linearity, operating ambient temperature conditions and other major technical indicators of conventional sensors are regulated;

Appendix B: requirements of different types of bridge in use period monitoring: the monitoring technical points of girder bridge, arch bridge, cable-stayed bridge, suspension bridge and railway bridge are regulated, respectively.

4. Technical levels, roles and benefits of the code

4.1 Technical levels of the code

The code preparation group prepared a comprehensive summary of the research results and practical experience in engineering structural monitoring of buildings and bridges in recent years, drawing on advanced foreign technology and the corresponding codes, and in the process of preparing the relevant thematic studies carried out to obtain the corresponding study results, and applied the provisions of written specifications. This code reasonable set of major technical indicators to meet the needs of the construction, operational applicability, no major problems left over to fill the gap, on the whole reached the international advanced level.

4.2 Roles and benefits of the code

Implementation of this specification will be directly used to monitor a variety of building and bridge structures, it offers a theoretical basis and technical requirements for the monitoring and post-assessment during construction and use period of structures, monitoring techniques to clearly regulate the work of our engineering junction; while standardize reasonable monitoring technical work, both to ensure the safe use of the building and bridge structures, but also for the country save a lot of materials and resources.

Monitoring of construction period and use period of building structures and bridges, from the source to define the carrying capacity of inadequate or unsafe engineering structures, providing a theoretical basis for structural repair as soon as possible, can greatly reduce the structural damage due to natural causes or human factors, and reduce the extent of damage to engineering facilities, improving disaster prevention capacity building and service life, ensure the normal order of people's lives and social stability.

This code is implemented to fill the blank in this technical field which is still no national criteria to guide, with the strategic requirements of sustainable development and a wide range of applications. Significant economic and social benefits will be earned after the implementation of the code.

5. Main work in the future

Monitoring technology of engineering structures such as buildings and bridges, especially complex structures is evolving interdisciplinary last three decades, covering different aspects of civil engineering, electronics, information networks and signal processing. The monitoring technology is developing rapidly. Therefore, the implementation of this code, still need to work closely tracking the latest trends at home and abroad to monitor areas and constantly reinforce the monitoring technology content; further research to refine the technical specifications suitable for monitoring different structural systems, components and nodes; further study of the monitoring and evaluation methods of structural components and nodes injury, to construct structural health database of buildings and bridges in order to establish an accurate calculation model of structures, components and nodes, to accurate assessment of the reliability of the structure is also needed; in addition, with the continuous extension of the monitoring period, updates problems of monitoring system and durability problems of monitoring equipment are more obvious, therefore, to develop and standardize monitoring systems and equipment durability is worth further study.

6. REFERENCES

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