# RESEARCH ON ENVIRONMENTAL MONITORING PLATFORM AROUND URBAN DEEP FOUNDATION PIT

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Absrtact: in view of the characteristics that the construction activities of urban deep foundation pit can easily bring irreparable influence to the surrounding environment, the traditional monitoring of the surrounding environment of urban deep foundation pit is difficult to satisfy the visualization of the overall surrounding safety state. It is difficult to judge the trend of the whole surrounding environment. Therefore, the web system of real-time monitoring, data analysis and early warning control of the surrounding environment of urban deep foundation pit based on BIM cloud platform technology is studied to realize the overall picture of the safety state of the surrounding environment.

***Key Words :*** *Urban deep foundation pit, surrounding environment,BIM, information integration platform*

## 1.INTRODUTION

The rapid development of regional central cities leads to the tension of urban land use. In recent years, the development of underground space has been continuously strengthened, and the urban deep foundation pit project has been developed rapidly. The urban deep foundation pit project is located in the downtown city, with dense tall buildings and underground pipelines complex. The construction process of urban deep foundation pit can easily bring irreversible damage to the surrounding environment.

In order to ensure that less construction process affects the surrounding environment, the

surrounding environment of the site is monitored to prevent danger in advance. At present, the foundation pit monitoring mainly adopts the monitoring means of manual monitoring, and a large number of monitoring points are arranged on the site. The relevant personnel are responsible for collecting the monitoring data every day, and finally conduct manual statistical analysis. Such monitoring method is low efficiency and difficult to meet the current environmental monitoring demand of deep foundation pit[1]. At the same time, the analysis results of manual monitoring are not very high in accuracy, and it is difficult to comprehensively feedback the actual situation of the surrounding environment of the foundation pit, so that it is difficult to prevent the occurrence of risks.

Thus, it can be seen that the current environmental monitoring means of urban deep foundation pit urgently need to be improved. How to collect and quickly analyze the monitoring data in real time to provide a reliable plan for the surrounding environmental protection in the next stage, so as to ensure the smooth construction process of urban deep foundation pit. Information technology is a good solution. Tan Fengyi, Wang Min, Yu Jining [2] built deep foundation pit information monitoring system based on information technology and used to guide construction optimization; Wu Zhenjun and other [3] used distributed information technology to build foundation pit monitoring management and early warning system, improve the safety index in foundation pit construction; Xie Xiaosong and Xu Wei[4]realized dynamic monitoring of deep foundation pit based on information technology, and applied in Wuxing Yangluo Yangtze River Bridge, achieved good results. The above research of scholars provides optimization for the foundation pit engineering monitoring link through information means, but the current monitoring effect of urban deep foundation pit is still not ideal. This is mainly due to the greater complexity of the surrounding environment of the urban deep foundation pit, even if the information means can quickly collect data and analysis, the results of the analysis are difficult, it is difficult for site managers to carry out reasonable analysis. How to provide information monitoring and analysis results with more intuitive methods is particularly critical.

In recent years, BIM technology has developed rapidly, which has been widely used in the engineering industry with the advantages of visualization, informatization and collaboration, and many scholars have applied BIM technology to the foundation pit monitoring. Li Jianfei[5]uses the combined model to build a foundation pit monitoring system, which improves the prediction function in the foundation pit monitoring process. Liu Suzhen, Li Qiang, Yang Meng, and other[6]used BIM technology to process the foundation pit monitoring data, and reflect it intuitively. Han Daguang, Qin Cheng, Zhou Yin, and other [7]from the perspective of the new technology, using BIM technology and 3 D laser scanning, to compare and analyze the changes before and after the foundation pit, to realize the visualization of the foundation pit monitoring. However, the visualization application of the current BIM technology in the foundation pit monitoring is generally effective, because it does not better apply the monitoring data, and the visualization needs to be built on the sufficient monitoring analysis results in order to play its maximum value.

Therefore, based on the pain point of environmental monitoring, the dynamic visual analysis of the monitoring process. At the same time, considering many complex factors in the actual application process, the WEB-end monitoring platform was developed based on BIM information technology, aiming to improve the monitoring level of the urban deep foundation pit and ensure the safety of construction.

## 2.DEVELOPMENT OF BIM INFORMATION MONITORING PLATFORM

### (1)Establishment of Environmental Information Identification Model around Urban Deep Foundation Pit

In order to enable the BIM model to reasonably interact with the monitoring information on the Web end, the traditional BIM modeling mode is difficult

to meet the needs. The parametric model construction of the urban deep foundation pit and surrounding environment was completed through the BIM mainstream BIM modeling software Revit and its secondary development plug-in Dynamo. The important interaction part with the Web end of the model has three parts: surrounding roads, surrounding structures and the embankment of the Yangtze River. Each part is divided into several subsections through parametric programming and set its IFC information to facilitate the interaction with the monitoring information at the later stage. The information identification model created is shown in **Figure 1**.

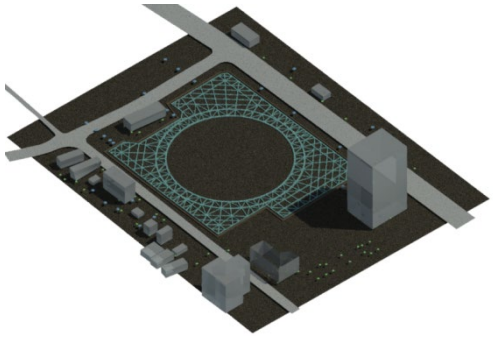

**Fig.1** Model with Information recognition function

**(2)BIM Cloud Platform Construction Based on B/S Architecture**

The B/S (Brower / Server, Browser / Server) mode, also known as the B/S architecture, is a network structure mode after the rise of Web. The Web browser is the main client application software, and this B/S mode shows the following advantages in the application:

a)Unified the client, concentrating the core part of the system function on the server, and simplifying the development, maintenance and use of the system;

b)Only one browser is installed on the client, and the corresponding database installed on the server can remain running;

c)The browser interacts with the database through Websever, which greatly facilitates the analysis of a lot of data.

BIM technology is a digital tool for integrate geometry and actual information, which can integrate information at all stages of the project and analyze and transmit this information.In the environmental visualization system around the urban deep foundation pit, the BIM model integrates multi-source data such as monitoring instrument number and monitoring location. At present, most BIM technology applications exist in the form of software, with large models and difficult sharing and transmission. In the environmental monitoring process around the urban deep foundation pit, the traditional application mode is difficult to play its value. Therefore, this paper realizes the display of BIM information model at the WEB end based on the three-dimensional model lightweight technology, and its principle is shown in **Figure 2**.

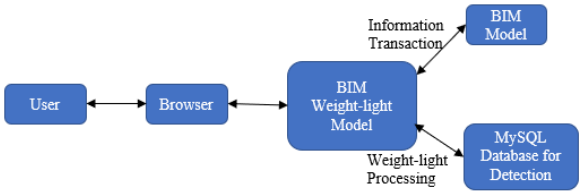


**Fig.2** WEB-end BIM lightweightprinciple

**(3)Function introduction of environmental visual monitoring system around urban deep foundation pit**

The visual monitoring system provides monitoring data uploading, data visualization analysis and automatic early warning functions for the surrounding environment of the urban deep foundation pit. The following is the analysis of specific functions:

**a)Monitoring and data upload function**

According to the surrounding environment and its complex urban deep foundation pit, it is often necessary to arrange a lot of monitoring points to judge the settlement, horizontal displacement and tilt cracking trends of the surrounding environment in the later stage. In the past, manual and instrument measurements were used to monitor the surrounding

environment, and the results required artificial statistics. The process was extremely complicated and prone to data loss errors, which brought great hidden dangers to the risk control of the surrounding environment. Through the monitoring data upload function, the monitoring personnel on the surrounding environment monitoring data, data input to the corresponding monitoring control points, the daily fixed time system will automatically count the monitoring information on the day, to remind the relevant personnel to input information, when the information is completed, the data analysis of the monitoring information on the day.

**b)Data visualization and analysis function**

After collecting the data monitored on the same day, the system will conduct the monitoring data analysis according to the set steps. After data analysis, it can provide the overall change of settlement, displacement and tilt degree of each monitoring points on the day, and color the buildings in the interval corresponding to greatly changing monitoring points. The system is divided into four levels on surrounding environmental safety, green-almost no influence; yellow has slight influence; orange-has great influence; red-has had influence. Analysis of the monitoring point data can reflect the redundant monitoring reports on the BIM model to visually perceive and prevent the project managers in advance. At the same time, visual analysis of the cumulative monitoring of an industrial control or stage can be conducted, to provide visual basis for the effective formulation of the on-site construction scheme.

**c)Automatic early warning function**

This function involves two parts. The first is that when the monitoring information collected daily monitoring points exceeds the safety value set by the system, the system will automatically remind the project management personnel to investigate the immediate situation, analyze whether the warning is caused by wrong human input information or bad changes in the construction environment in an area, and take timely measures. Second, when the on-site inspection personnel observe the changes of the construction surrounding environment, they can obviously intuitively feel the settlement, displacement and cracks, and the change time is very short. At this time, the on-site inspection personnel can directly log into the system and use the label function in the system to locate and give early warning of the area. Avoid not passing information quickly and effectively, thus delaying the best time to protect the surrounding environment.

Through the above three functions, the monitoring situation of the daily and cycle of the urban deep foundation pit can be traceable, visual analysis and early warning, optimize the deep foundation pit monitoring process by the system, and bring intuitive and convenient monitoring services to the actual construction process, as shown in **Figure 3** and **Figure 4**.

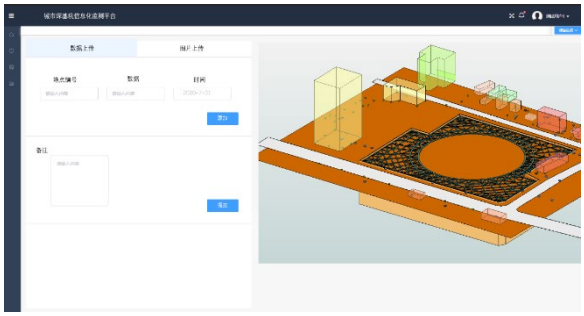

**Fig.3** File upload function of visual monitoring system

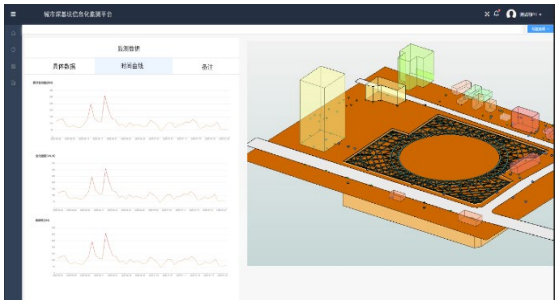

**Fig.4** Data analysis visualization function interface

## 3.SUMMARY AND PROSPECT

Through the excavation and exploration of BIM information technology, this paper has made the advantages of visualization and information integration applied to the environmental safety monitoring around the urban deep foundation pit. BIM lightweight technology is used to carry the

model to the WEB end, and realize monitoring information uploading, data analysis visualization and early warning functions in a unified platform. The visual analysis effect of previous scholars, BIM and monitoring system in this field are optimized, facilitating site management to feel the surrounding environment and immediately control the next stage.

At the same time, for monitoring information and BIM model visual interaction function still needs to improve, complex construction environment is often rapidly changing, at present visual data analysis only provides the mining of monitoring information results, provide visual data analysis display still need to perform a lot of feasibility demonstration analysis, looking forward to continue to explore the study of service optimization of visual monitoring.

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