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Risk Factors and Countermeasures in Construction Engineering Supervision

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Abstract: Taking Guangdong South China University of Engineering Construction Supervision Co., Ltd. as the research object, this article analyzes the risk factors and countermeasures in construction project supervision. This article studies the common risk types of technology, management, safety and law in China, and discusses the risk causes and control strategies of high-risk projects such as deep foundation pit engineering and pile foundation construction through typical cases. Some suggestions are put forward to improve the level of supervision risk management, such as strengthening personnel training, popularizing the application of BIM technology and improving the internal management system. It is pointed out that the supervision unit needs to optimize the risk identification and response ability to ensure the project quality and construction safety, which has practical reference value for improving the scientific and normative supervision work.

1. Introduction

With the continuous acceleration of urbanization in China, the scale of various construction projects is expanding and the engineering structure is becoming more and more complex. As a result, there are more stringent requirements for engineering quality and safety. In this case, construction project supervision, as a key means to ensure project quality and control construction progress and investment, is becoming more and more important [1]. However, in practice, due to technical difficulties, long management chain and changeable external environment, the supervision work faces many risks and challenges [2]. Guangdong South China University of Engineering Construction Supervision Co., Ltd., as a well-known professional supervision enterprise in Guangdong Province, has long been involved in the supervision of various industrial and civil construction projects and accumulated rich practical experience [3]. In the process of project promotion, the company not only shoulders the heavy responsibility of supervising the quality, safety and progress of the project, but also needs to coordinate the relationship between the construction unit, the construction unit and the design unit [4]. In this process, risks caused by unreasonable technical scheme, inadequate on-site management, and uneven quality of personnel occur from time to time, which has a certain impact on the project progress.

This article takes Guangdong South China University of Technology Engineering Construction Supervision Co., Ltd. as the research object, and analyzes the main risk factors encountered in the

project. By combing the requirements of relevant policies and regulations, combined with typical engineering cases, this article discusses the manifestations and causes of different risk types, and puts forward corresponding countermeasures. The purpose is to provide risk management ideas for supervision enterprises in practical work and improve the scientificity and effectiveness of supervision work.

2. Background of policies and regulations and responsibilities of supervision units

For a long time, the engineering construction industry in China has paid special attention to the quality and safety of the project. As a key means to ensure the standardized operation of the construction process, engineering supervision plays an irreplaceable role [5]. In recent years, the state and local governments have continuously promulgated and improved relevant policies and regulations, with the aim of further clarifying the legal status, responsibilities and regulatory requirements of supervision work and promoting the development of supervision industry towards specialization and standardization.

As an economically developed area in China, Guangdong Province has an active construction market and a variety of engineering projects, which undoubtedly sets a higher standard for supervision. Since the implementation of the Regulations on Construction Engineering Supervision in Guangdong Province, it has provided basic institutional support for the supervision activities of various construction, civil, electromechanical and other projects in the province. This regulation defines the project supervision clearly, that is, the supervision unit is entrusted by the construction unit to supervise and manage the project quality, progress and investment within the scope agreed in the contract [6]. Futhermore, the regulations stipulate the types of key projects that must be supervised, such as national or provincial key projects, industrial transportation projects with a cost exceeding a certain amount, residential quarters with a large total construction area, etc., and strengthen the supervision of engineering projects from the source.

3. Main risk factors in construction project supervision

Although the supervision system is constantly improving, there are still many risk factors that affect the supervision effect in actual engineering projects. These risks run through the whole project implementation process, involving technology, management, safety, law and other aspects. A little carelessness may lead to quality problems and even safety accidents, which will bring serious consequences to the project construction. As shown in Figure 1, the typical vertical cracks in the basement project of Zhuhai Port of Hong Kong-Zhuhai-Macao Bridge, with a spacing of 2-5m, are mainly caused by the tensile stress exceeding the tensile strength caused by concrete temperature and shrinkage deformation.

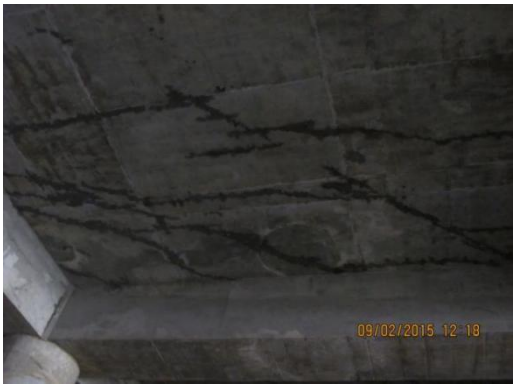

Figure 1 Basement crack

The first is technical risk. With the continuous development of engineering technology, the engineering structure is becoming more and more complex, and the application of new materials and new processes is becoming more and more extensive, which puts forward higher requirements for the technical judgment ability of supervisors [7]. For example, in high-risk operations such as deep foundation pit support, pile foundation construction and long-span roof structure, if supervisors fail to find defects in design or construction in time, it may lead to problems such as unstable support and excessive settlement, which will further affect the overall structural safety [8]. In addition, some special geological conditions (such as soft soil layer, sand layer, etc.) may also cause foundation deformation or collapse accidents due to improper handling.

Next is the issue of risk management. The construction of engineering projects involves many subjects, so it is difficult to coordinate. As an independent third party, supervision units often face problems such as poor communication and asymmetric information when coordinating the relationship between construction units, construction units and design units. For example, in order to catch up with the construction period, some construction units may have illegal behaviors such as rushing to work and skipping work procedures, and the construction units have not given enough support, which makes it difficult to effectively promote the supervision work. In addition, incomplete construction materials, frequent changes and lagging drawings will also affect the accuracy and timeliness of supervision work.

The third is security risks. The construction site environment is complex, and high-risk operations such as aerial work, temporary power consumption and hoisting are frequent. Once the supervision is not in place, safety accidents are prone to occur. For example, problems such as nonstandard scaffolding, lack of protective measures, and unlicensed work of special operators may all become hidden dangers of accidents. Although most projects have full-time safety officers, if there is no effective supervision mechanism, the problem of safety supervision is still common.

Finally, there are legal and contractual risks. Due to the unclear terms of the project contract and the unclear division of responsibilities, the supervision unit often faces the problem of vague definition of responsibilities in practical work. For example, after some projects have quality problems, the responsible parties shirk each other, and the supervision unit may be implicated and bear undue legal responsibilities. In addition, some projects have problems such as arrears of supervision service fees and difficulties in contract performance, which also affect the enthusiasm and stability of supervision units to some extent.

4. Countermeasures for typical risk projects

As a common high-risk operation in current urban buildings, deep foundation pit engineering is difficult to construct, with high technical requirements and complex environmental impact. If it is handled improperly, it will easily lead to serious consequences such as support instability, settlement of surrounding buildings and even ground collapse. For example, a commercial complex project in which South China University of Technology Supervision Company participated is faced with complicated geological conditions and high groundwater level.

In this regard, South China University of Technology Supervision Company has taken a series of countermeasures. On the one hand, the strict review of the construction plan and expert demonstration of the support plan ensure the rationality and scientificity of the technical plan; On the other hand, the strengthening of on-site supervision system and the full process supervision of key processes ensure that the construction quality meets the design requirements. In addition, the increase in monitoring frequency and the establishment of an automatic monitoring system have enabled real-time monitoring of excavation deformation and settlement data of surrounding buildings. In addition, an emergency plan should be formulated to clarify the response processes

such as personnel evacuation, equipment evacuation and emergency reinforcement in case of sudden danger. Table 1 shows the comparison of supervision control measures and implementation effects of several typical engineering projects.

Table 1 Comparison of Supervision Measures and Implementation Effects for Typical High-Risk Projects

Project Type	Supervision Measures	Problem Occurrence Rate Before Implementation (%)	Problem Occurrence Rate After Implementation (%)	Risk Reduction (%)	BIM Technology Used?	Number of Safety Incidents (During Construction)
Deep Foundation Pit Engineering	Expert review, full-process site supervision, automatic monitoring system	18%	5%	72%	No	2
Pile Foundation Engineering	Geological report review, control of mud specific gravity, combined static and dynamic testing	12%	3%	75%	Yes	0
Super-Long Basement Concrete Structure	Reinforcement optimization, temperature control, extended curing time	25%	9%	64%	No	1
Long-Span Metal Roof	Structural optimization, construction process control, real-time wind load monitoring	20%	6%	70%	Yes	1
Demolition Blasting Engineering	Emergency plan formulation, on-site supervision, evacuation drills	30%	10%	67%	No	2

Figure 2 Wind resistance measures

By strengthening pre-technical review, whole-process supervision and introducing digital tools such as BIM, the problem rate of various high-risk projects has been reduced by about 70% on average, and the construction safety and engineering quality have been improved. Especially in pile foundation engineering and deep foundation pit engineering, under the strict supervision and control, the safety accidents are almost zero. This reflects the important role of scientific and standardized supervision management in risk prevention and control.

As the foundation structure of a building, the construction quality of pile foundation directly affects the overall structural safety. Under geological conditions such as soft soil layer and sand layer, pile foundation construction is prone to problems such as deflection and insufficient bearing capacity. Facing the wind resistance of large metal roofs, Guangdong South China University of Technology Engineering Construction Supervision Co., Ltd. has taken a series of targeted measures, as shown in Figure 2. These measures effectively improve the wind resistance of the roof by optimizing the structural design, strengthening the construction technology control and real-time monitoring.

Taking a high-rise residential project as an example, there is a thick soft soil layer in the project site, and the pile body is prone to tilt and the sediment is too thick during construction. South China University of Technology Supervision Company has adopted the practices shown in Table 2.

Table 2 Main Control Points and Supervision Measures at Each Stage of Pile Foundation Construction

Control Link	Specific Measures
Pre-construction Preparation	Review geological survey reports and optimize pile foundation layout schemes
Construction Process Control	Strengthen control of mud specific gravity to ensure hole stability during formation
Quality Inspection	Adopt a combination of static load tests and dynamic testing methods to ensure single-pile bearing capacity meets standards
Supervision Methods	Implement full-process tracking inspections and rectify issues promptly upon discovery

In recent years, with the increase in the number of large-scale underground space development, the crack problem of concrete structure in super-long basement has become more and more prominent, which has become one of the key factors affecting the quality and durability of the project. For example, in an underground garage project, South China University of Technology Supervision Company adopted a series of control strategies in the face of temperature difference contraction and unreasonable reinforcement. First of all, in the aspect of optimization design, thin and dense reinforcement method is adopted, and the spacing of post-poured strip is shortened; Secondly, temperature difference control measures include selecting low heat cement and strictly controlling the temperature of concrete entering the mold, thereby effectively reducing the temperature difference inside and outside the structure. In addition, strengthening maintenance work can effectively prevent the occurrence of early cracks in concrete by extending the insulation and moisture retention time; Finally, dynamic monitoring is carried out, and grouting sealing treatment is carried out to prevent the micro-cracks from expanding further.

5. Suggestions for improving the level of supervision risk management

Facing the increasingly complex engineering environment and the ever-increasing regulatory requirements, supervision units must constantly optimize the internal management system, improve the quality of employees, and actively introduce new technical means to achieve more efficient and

accurate risk management.

Supervision work has a strong professionalism, which requires supervisors to have a solid technical foundation and rich practical experience. In order to strengthen the professional ability of supervisors, it is needed to improve the training mechanism. On the one hand, we can establish a regular training mechanism and invite industry experts to teach; On the other hand, employees are encouraged to take various registration examinations, such as registered supervision engineers and builders. In addition, case teaching should be carried out to improve the problem-solving ability of employees by analyzing actual projects.

Traditional supervision work relies on manual inspection and paper records, which is not only inefficient, but also lags behind in information. With the help of BIM technology and digital platform, many changes can be brought about. South China University of Technology Supervision Company has applied BIM technology in some projects and achieved good management results.

Establishing a sound internal risk identification and response mechanism is the key to improve the level of supervision management. It is suggested to start with several aspects as shown in Table 3.

Table 3 Summary of Key Operational Points for the Full Process of Risk Management

Management Dimension	Specific Practices
Risk Identification	Establish a list of common risks and manage them by classification and grading
Risk Assessment	Introduce the R=L ×S model to quantify risk levels
Response Mechanism	Develop emergency plans and clarify responsibility allocation
Experience Summary	Conduct risk review after each project to form an improvement mechanism

Supervision is not only a technical activity, but also a responsibility activity. The professional ethics of supervisors is directly related to the quality and safety of the project. Construction project supervision is a highly specialized job. Facing the ever-changing risk challenges, the supervision unit must start from personnel quality, technical means, management system and other aspects to comprehensively improve the ability of risk identification and response.

6. Conclusions

By analyzing the supervision practice of Guangdong Huagong Engineering Construction Supervision Co., Ltd., this article reveals the risk problems faced by construction engineering supervision and gives solutions. Supervision work is not only on-site supervision, but also deeply involved in the whole process management and plays a key role in risk identification.

In policy, relevant regulations provide guarantee for the standardization of supervision industry. However, in practice, the complexity of the project, the difficulty in coordination among the contractors and the rapid update of the construction technology have brought challenges to the supervision work, and the traditional supervision means are difficult to meet the demand.

Through case analysis, the supervision unit should strengthen the initiative and professionalism in technical review, and attach importance to team building and technical upgrading. For high-risk operations, it is needed to establish a risk assessment mechanism, arrange experienced supervisors to supervise on the spot, and use BIM technology to improve the efficiency and accuracy of supervision.

In the future, the development of the construction industry will promote the transformation and upgrading of the supervision industry, from "passive supervision" to "active service" and from "single quality control" to "whole process risk prevention and control". Only by improving the

professional ability and perfecting the management system can the supervision unit adapt to the development of the industry and realize the value of engineering supervision.

References

[1] Yang Shuyun, Liu Hongzhi, Li Haisheng. Risk Assessment of Information Engineering Supervision Based on Improved Two-Dimensional Cloud Model [J]. Science Technology and Engineering, 2023, 23(26): 11292-11298.

[2] Fu Shengliang. Discussion on Professional Liability Insurance for Construction Supervision [J]. Construction Economy, 2024, 45(8): 10-14.

[3] Li Jue, Li Jiawen. Analysis of Risk Factors for Building Collapse Accidents Based on STAMP-HFACS [J]. Journal of Engineering Management, 2022, 36(5): 148-153.

[4] He Zhenghao, Tian Yuanfu. Safety Risk Factors in Prefabricated Building Construction from the Perspective of Participating Units [J]. Science Technology and Engineering, 2023, 23(1): 321-326.

[5] Li Qiong, Pang Min, Zhong Hong, et al. Research on Coupling of Explosion Risk Factors in Chemical Enterprises Based on N-K Model Social Network [J]. Journal of Safety and Environment, 2024, 24(12): 4581-4590.

[6] He Zhilin, Wang Jiayuan, Li Jie. Research on Green Building Construction Cost Risks from the Perspective of Stakeholders [J]. Journal of Engineering Management, 2020, 34(02): 135-140.

[7] Ke Lin. Research on Data Processing Methods for Power Engineering Based on Multi-Source Data Fusion and Fuzzy Clustering [J]. Electronic Design Engineering, 2023, 31(24): 163-167.

[8] Zhao Dongbo, Yan Kewu, Wu Xiaoguang, et al. Safety Supervision Practice of Demolition Blasting for Single-Tower Single-Cable-Plane Prestressed Cable-Stayed Bridges [J]. Engineering Blasting, 2024, 30(3): 69-73.