

Measures for Prevention and Control of Hydrogeological Investigation Issues

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Abstract: Hydrogeological investigation is an important part of water conservancy engineering, often facing issues such as inaccurate data, improper methods, and safety risks. This article proposes preventive measures. Enhancing the quality and technical level of survey personnel, introducing advanced technology and equipment, establishing strict survey standards and procedures, and strengthening safety management are suggested. These measures aim to improve the accuracy and efficiency of surveys, ensuring the safety and stability of engineering projects. Implementing these measures can provide solid geological support for water conservancy projects and promote sustainable development.

Keywords: Hydrogeological investigation; issues; preventive measures

Introduction

Hydrogeological investigation is an indispensable part of water conservancy engineering, involving in-depth investigation of groundwater, surface water, and environmental geology. However, in the actual survey process, issues such as inaccurate data, improper method selection, and safety hazards are often encountered. These problems may have a negative impact on the safety and stability of the project. This article aims to discuss common issues in hydrogeological investigation and propose corresponding preventive measures to improve the accuracy and efficiency of survey work, ensuring the smooth and safe progress of water conservancy projects.

1. Basic Content and Methods of Hydrogeological Investigation in Water Conservancy Engineering

Hydrogeological investigation is an indispensable component of water conservancy engineering, involving comprehensive understanding and analysis of groundwater, surface water, and environmental geological conditions. To ensure the safety, stability, and efficient operation of water conservancy projects, hydrogeological investigation plays a crucial role. The basic content of hydrogeological investigation mainly includes the following aspects:(1). Assessment of Groundwater Resources: Detailed investigation and evaluation of groundwater reserves, distribution, recharge, and discharge conditions to provide water



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resource support for water conservancy projects.

(2). Analysis of Surface Water Conditions: Study of characteristics such as water level, flow rate, and water quality of surface water bodies like rivers, lakes, etc., analyzing their impact and interaction with water conservancy projects.

(3). Assessment of Engineering Geological Conditions: Detailed survey of engineering properties, geological structures, underground chambers, etc., to assess their impact on the stability of water conservancy projects.

(4). Analysis of Hydrogeological Conditions: Study of the relationship between groundwater and surface water, including dynamic changes in groundwater levels, and the influence of hydrogeological conditions on water conservancy projects.

(5). Evaluation of Environmental Geological Conditions: Assessment of the adaptability of regional geological environments to water conservancy projects, including potential threats from natural disasters such as earthquakes, landslides, debris flows, etc.

Common methods of hydrogeological investigation in water conservancy engineering include:

(1). Drilling Method: Obtaining core samples through drilling to understand the characteristics such as thickness, lithology, and structure of underground rock and soil layers.

(2). Trenching Method: Observing the geological conditions of surface rock and soil layers by excavating trenches, suitable for shallow geological condition surveys.

(3). Geophysical Exploration: Using geophysical methods such as electrical, magnetic, seismic, etc., to indirectly detect underground geological conditions.

(4). Hydrogeological Testing: Including pumping tests, water pressure tests, etc., to measure the dynamic changes in groundwater levels and hydrogeological parameters.

(5). Environmental Monitoring: Utilizing remote sensing, geographic information systems, etc., to continuously monitor regional environments and assess their impact on water conservancy projects.

During the process of hydrogeological investigation in water conservancy engineering, attention should be paid to: Ensuring the authenticity and accuracy of survey data to avoid errors or false data. Selecting appropriate survey methods and means according to the actual needs of the project to ensure the comprehensiveness and effectiveness of survey results. Strengthening safety management to ensure personal and equipment safety during the survey process.

2. Common Issues in Hydrogeological Investigation in Water Conservancy Engineering

Hydrogeological investigation is a crucial component of water conservancy engineering. However, in practical operations, various issues may arise that could potentially impact the survey results, subsequently affecting the safety and stability of the entire project.

Firstly, inaccurate survey data is a common problem. The accuracy of survey data is fundamental for assessing geological conditions and evaluating engineering risks. However, errors in survey data may occur due to factors such as equipment precision, operator skill level, and environmental conditions. This could pose potential safety risks for engineering design, construction, and management. To address this issue, routine maintenance and calibration of equipment should be reinforced, and the professional competence and skills of operators should be improved. Additionally, environmental factors should be thoroughly considered during the survey process to ensure data accuracy.

Secondly, improper survey methods can lead to inaccuracies in results. The selection of survey methods directly affects the accuracy and comprehensiveness of survey results. In practice, inadequate understanding of geological conditions or lack of experience may lead to the selection of inappropriate survey methods, resulting in survey results that do not accurately reflect the geological conditions. Therefore, strengthening research and analysis of geological conditions is necessary, and appropriate survey methods should be selected based on the actual needs of the project. Furthermore, training and education for survey personnel should be enhanced to improve their professional competence and skills.

Lastly, safety hazards during the survey process are a significant concern. Hydrogeological investigations often take place in the field, where environmental conditions are complex and dynamic, leading to inherent safety risks. For example, in mountainous areas, natural disasters such as landslides and debris flows may occur, while conducting surveys in water bodies may encounter rapid currents and fluctuating water levels. Hence, strengthening safety management and preventive measures are essential. Detailed safety operating procedures and emergency plans should be formulated to ensure the safety of personnel and

equipment during the survey process.

3. The Preventive Measures for Issues in Hydrogeological Investigation for Water Conservancy Engineering

3.1 Enhancing the Qualifications and Technical Skills of Survey Personnel

Survey work is the foundation of engineering construction, involving detailed investigation of geological conditions and assessment of potential risks for future projects. Therefore, survey personnel must possess solid professional knowledge, excellent technical skills, and strict adherence to safety regulations. Firstly, survey personnel need to have extensive geological knowledge. This includes a deep understanding of aspects such as geophysics, geological structures, soil composition, hydrogeology, and others. Only when survey personnel have a thorough grasp of these fundamental concepts can they accurately interpret survey data and provide reliable basis for engineering design. Secondly, the selection of survey techniques is crucial for obtaining high-quality survey data. With the development of technology, survey techniques are constantly evolving, and new equipment and methods emerge. Survey personnel need to continuously update their technical knowledge, master the latest survey tools and methods to improve work efficiency and data accuracy. Furthermore, safety awareness is an indispensable aspect of survey work. During field operations, survey personnel may encounter various complex environments and dangerous situations. Therefore, they must understand and comply with relevant safety regulations to ensure their own safety and that of their colleagues. To enhance the qualifications and technical skills of survey personnel, the following measures can be taken: (1) Regularly organize training courses. Through systematic training courses, help survey personnel consolidate and update geological knowledge, and learn the latest survey techniques and methods. (2) Invite experts to give lectures. Invite experts and scholars in the industry to share their experiences and insights, allowing survey personnel to learn from practical experience. (3) Conduct field operation drills. Simulate real survey environments to allow survey personnel to improve their skills in practical operations and enhance their

ability to respond to emergencies. (4) Encourage continuing education. Support survey personnel to participate in refresher courses, seminars, and professional conferences to facilitate their continuous learning and exchange of ideas. (5) Establish incentive mechanisms. By setting up reward and promotion systems, incentivize survey personnel to actively participate in training and enhance their skills.

3.2 Introducing Advanced Survey Technologies and Equipment

With the continuous advancement of technology, various innovative survey technologies and equipment have emerged, bringing unprecedented opportunities to the field of hydrogeological investigation for water conservancy engineering. To ensure the efficiency and accuracy of survey work, we should actively introduce these advanced technologies and equipment.

Firstly, unmanned aerial vehicle (UAV) aerial photography technology has received widespread attention and application in recent years. Equipped with high-definition cameras and sensors, UAVs can efficiently conduct aerial surveys in the designated areas, capturing high-resolution image data. These data can be utilized for terrain analysis, surface feature identification, geological hazard assessment, and more, greatly enhancing the efficiency and precision of survey work.

Secondly, geophysical exploration technology, as a non-destructive survey method, has been widely applied in hydrogeological investigation. By measuring changes in geophysical fields such as magnetic fields, gravity fields, and electric fields, information about underground rock structures, strata distribution, and groundwater conditions can be inferred. This information is crucial for evaluating underground water resources, predicting geological hazards, and formulating rational water conservancy engineering plans.

Furthermore, remote sensing technology, as a large-scale and high-efficiency survey method, also plays an important role in hydrogeological investigation for water conservancy engineering. Sensors mounted on satellites or aircraft can obtain extensive surface data, including terrain, vegetation coverage, water distribution, and more. These data can be used for water resource surveys, environmental monitoring, disaster assessment, and other purposes, providing

valuable information support for hydrogeological investigation.

To better utilize these advanced survey technologies and equipment, we should strengthen research and application efforts. This includes understanding their principles, mastering operation methods, analyzing data results, and continuously improving existing survey methods and techniques. Moreover, it is essential to integrate these new technologies and equipment with traditional survey methods based on practical considerations to achieve more efficient and accurate survey results.

3.3 Developing Strict Survey Standards and Procedures

Survey work plays a crucial role in various stages of water conservancy engineering, including planning, design, and construction. To ensure the safety, stability, and economic efficiency of engineering projects, it is essential to develop comprehensive and detailed survey standards and execution procedures tailored to the specific characteristics and practical needs of water conservancy engineering.

Firstly, the development of survey standards should cover multiple aspects including engineering geology, hydrology, environmental impact, and engineering technology. These standards should be based on relevant national and local regulations, norms, and industry best practices, combined with the actual situation of the project. They should clearly define the specific content of the survey, such as soil types, groundwater levels, river flow rates, and other key parameters. Additionally, the selection of survey methods should be scientifically rigorous, utilizing modern remote sensing technology, geographic information systems (GIS), on-site drilling, and sampling methods to obtain accurate and reliable data.

In terms of survey procedures, each stage of work content, timeline, responsible personnel, and output results should be clearly defined. The process should start from the preliminary assessment of the project, through to the preparation and submission of the final survey report. Each step should have clear operational guidelines and quality control measures. For example, during fieldwork, detailed sampling locations, depths, and methods should be specified to ensure the representativeness and integrity of the samples.

To ensure the authenticity and accuracy of

survey data, the survey team must strictly adhere to the established standards and procedures during operations. This includes not only standardized operations by field personnel but also precise data analysis and report writing afterward. Any deviation could lead to significant engineering risks, highlighting the importance of supervision and management of survey work. This involves regular progress checks, quality audits, as well as training and assessment of survey personnel to ensure they possess the necessary professional knowledge and skills.

During the survey process, if any anomalies in data or improper operations are detected, immediate corrective measures should be taken. If necessary, surveys should be conducted again to ensure the accuracy and reliability of the information obtained. Transparency in survey work is also crucial, and relevant stakeholders such as project owners, designers, and construction units should have access to survey data and reports for independent evaluation and verification.

3.4 Strengthening Safety Management and Preventing Safety Hazards

Strengthening safety management and preventing safety hazards are crucial safeguards to ensure the smooth progress of survey work. In survey work, we should establish a sound safety management system to address various safety risks and challenges that may arise.

Firstly, it is necessary to develop detailed safety operating procedures and emergency plans. These procedures and plans should cover all potential safety accidents, including equipment failures, personnel injuries, fires, explosions, and so on. They should be detailed down to every operational step to ensure swift and accurate responses under any circumstances. Additionally, we need to clarify the safety responsibilities of personnel at all levels. Everyone should be aware of their roles and responsibilities in safety management to ensure effective implementation. For example, project managers should be responsible for the safety of the entire project, while each employee should be responsible for their own safety and the safety of others.

During the survey process, we need to enhance safety education and training. Regular safety training should be conducted to raise awareness and emergency response capabilities. These trainings should cover

safety knowledge, operational skills, emergency response abilities, and more. Through these trainings, we can enhance personnel's safety awareness and enable them to take prompt and accurate measures when encountering safety issues.

Furthermore, regular safety inspections and assessments should be conducted. We should regularly inspect equipment, work environments, workflows, etc., to promptly identify and eliminate safety hazards. At the same time, regular safety assessments should be carried out to evaluate the effectiveness of our safety management system and identify areas for improvement.

Conclusion

Through in-depth research and discussion on the issues of hydrogeological investigation for water conservancy engineering, this paper has proposed a series of practical and feasible preventive measures. The implementation of these measures not only improves the accuracy and efficiency of survey work but also provides solid geological support for the safety and stability of water conservancy projects. Looking ahead, we will continue to focus on the innovation

and development of survey technologies, continuously refine preventive strategies, and adapt to increasingly complex geological environments and engineering requirements.

References

- [1] Tan, X. F. (2019). Discussion on Hydrogeological Investigation and Disaster Prevention Techniques for Water Conservancy Engineering. *Low Carbon World*, (24), 91-92.
- [2] Zhang, J. (2019). Discussion on Problems and Preventive Measures in Hydrogeological Investigation for Water Conservancy Engineering. *World Nonferrous Metals*, (16), 243-244.
- [3] Yang, Y. H. (2020). Analysis on Hydrogeological Investigation and Disaster Prevention Techniques for Water Conservancy Engineering. *Science, Technology, Innovation and Application*, (21), 44-45.
- [4] Wang, H. L. (2020). Exploration of Hydrogeological Investigation and Disaster Prevention Techniques for Water Conservancy Engineering. *World Nonferrous Metals*, (19), 211-212.