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Analysis on Precision Elevation Control Monitoring of Hydropower Project

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Abstract: This paper analyzes the construction process of the precision elevation control network of the hydropower hub project in combination with the Muzaffarabad Hydropower Project in Assad Kashmir. It mainly includes the process of layout, selection and embedding stone of the leveling line and testing and error analysis of the leveling measurement, etc. According to the elevation data calculated in this paper and the elevation values provided by the owner, it is found that the elevation value obtained by the leveling method used in this paper is within the error tolerance and the data is reliable. The measuring instrument used in this paper is the Leica DNA03 digital level, which automatically records the observation data. The results of the precise elevation control measurement of the hydropower project in this paper can be promoted in similar water conservancy projects.

1. Introduction

With the rapid development of China's social economy, and in order to improve the efficiency of water resources utilization, avoid the adverse impact of water resources on residents' lives, and protect China's limited water resources, there are more and more water conservancy projects. From the perspective of building construction, accurate measurement is the key to improving the quality of engineering projects. However, problems in the construction survey work in the water conservancy project will directly affect the overall quality of the project, the construction effect, and serious serious safety accidents, resulting in serious economic losses. It can be said that the accuracy of the accuracy of construction surveys has a very important impact on the actual quality of hydraulic engineering [1].

The construction of water conservancy projects is a project with a wide scope of construction, complicated technology, large environmental disturbances, many management links, many hidden dangers and high risk factors. Once a safety production accident occurs, property losses are large and there are many casualties. Therefore, the safety management should not be neglected. It is necessary to establish and improve safety management institutions in strict accordance with industry norms, formulate and implement various safety management systems and measures, and contain or eliminate potential safety hazards of water conservancy projects from root trees to avoid the occurrence of safety accidents. Construction of water conservancy projects to ensure the safety of project construction [2]. In recent years, with the increase of the state's investment in the water conservancy industry, various water conservancy projects have been launched, and the safety of water conservancy projects has gradually emerged. The implementation of safety regulations and standards has deepened the construction of civilized construction, especially for the construction of water conservancy projects. The accuracy of water conservancy elevation control measurement directly determines the deformation monitoring accuracy of hydraulic engineering during construction and normal operation [3-5]. Therefore, the elevation control measurement requirements for hydraulic engineering are high.

This paper will use the Leica DNA03 digital level to monitor precision elevation control in conjunction with the Muzaffarabad Hydropower Project in Assad Kashmir.

2. Project Overview

The project is located in the Muzaffarabad district of Assad Kashmir. The area is steep and mountainous, with a mountain height of between 900m and 1000m. The project is divided into three main areas: the head, the middle and the tail. The head is located in Nausei/Panjkot, east longitude: 73° 43′ north latitude: 34° 23′, and the altitude is about 1000m. The main buildings here are dams, grit chambers and water inlets, about 41 km from Muzaffarabad. The middle is located in Thotha/ Majhol, east longitude: 73° 35' north latitude: 34° 15', altitude is about 800m, main building is A3, A4 branch hole; The tail is located in Chattar Kalas/Zaminabad, east longitude: 73° 29', north latitude : 34° 12′, the altitude is about 700m, the main buildings are underground powerhouse and tail water hole. The total length of the diversion tunnel is 28.55km, which is the control project of the whole project.

3. Layout of the standard route

The first-level measurement and control network installation facilities of water conservancy projects need to check the relevant measurement data provided by the supervision company according to the construction sequence, and ensure that the construction materials and measurement data do not exceed the standards before the construction of the main project. In the verification process, it is important to analyze the relevant control points of the measurement control network and their corresponding symbols, and if necessary, make multiple measurements. Approve water and control points to understand and record relevant hydrogeological data. The point of the standard point is familiar with the location of the mark; understand the administrative division of the construction area and the basic natural conditions. Combined with the actual situation of the project and the basic principles of the layout of the standard route, the project adopts a closed level route.

The project team uses the benchmark point SBM-13 at Garhi Dopatta as a reference point to route precision roads along the roads to Chattar Kalas and Nauseri. The total length of the precision level route is about 180km. A total of three standard routes have been set up, namely:

The 1st Precise Level Route: Starting from the Garhi Dopatta SBM-13 reference point, along the left bank of the Jhelum River to the working base of the suburb of Muzaffarabad, return to the SBM-13 level starting point to form a level line with a length of 44 km. The name is GM;

The 2nd Precise level line: From the suburb of Muzaffarabad, work along the road to the Zaminabad plane control point NJ305, and then return to the working base of the suburb of Muzaffarabad to form a standard route. The route is about 54 kilometers long and the line name is M-Z;

The 3rd Precise level line: From the suburb of Muzaffarabad, work along the road to the CGGC camp in the Nauseri area, and return to the working base of the suburb of Muzaffarabad to form a standard route with a length of 84 kilometers and the level line name is M-N.

4. Point selection and stone buried

Select the point along the road where the level line is arranged, set a level point every 1.5~2.0km, and encrypt the leveling point in the special area. The basic principle of selecting the point is: firstly, the point must be stable for long-term storage, followed by satisfying The need for the detection of the original precision elevation control points and the need for subsequent construction stakeout [6].

There are 58 precision reference points and working break points. According to the site geological conditions, two kinds of standard stones, precast concrete level stone and bedrock level stone, are used. The level points are numbered according to different areas:

(1) The G-M section of the level line is numbered from Garhi Dopatta to the suburban working base of Muzaffarabad according to BM09 to BM18 and NB01 (other points TBM08, GPS-4);

(2) The M-Z section of the level line is numbered from the working base point of the suburb of Muzaffarabad to Zaminabad according to BM01 to BM08 and M4, M5, TT1, TT2 (the other points CBM05, CBM06, CBM12);

(3) The M-N section of the level line is numbered from the base of the suburb of Muzaffarabad to Nauseri according to BM19 to BM39 and C1A, C1B (the other points are NBM03, NBM34).

All standard stones are divided into two types of standard stones, one is the concrete level standard, one is the pre-embedded stone on the hard bedrock surface, and the standard core is the processed steel head. The foundations of all standard stones are first excavated to reproduce the concrete standard stone. For the standard built on the hard bedrock, the surface loose rock and dirt should be removed according to the site conditions to ensure that the foundation concrete and the bedrock are integrated. And then punctuate. Punctuation concrete is cured for at least 3 days to ensure normal solidification of concrete. All standard points are marked with the stone number [7]. A schematic diagram of the standard stone is shown in Figure 1:

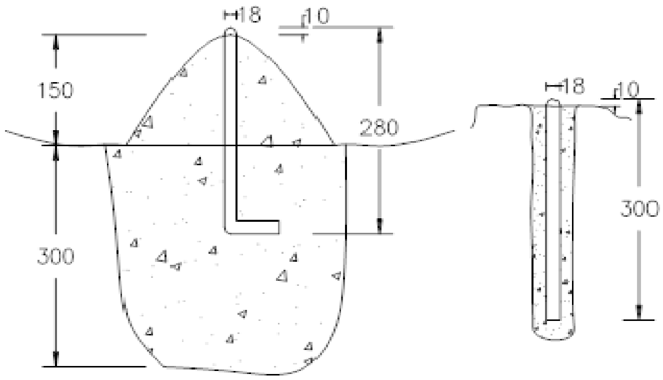

Fig.1 Concrete level stone diagram (unit: mm)

5. Horizontal line measurement

This article uses the Leica DNA03 digital level to automatically record observations. According to the national standards for precision leveling, the observation and return procedures are carried out on the level line. The observation procedure uses the aBFFB observation program built in the instrument. The procedure is abbreviated as follows: when it is an odd station, the "post-pre-front-back" observation is adopted. Order, when used as an even station, the "pre-post-post-pre-" observation order is used. The front and rear line of sight of each station are accurately measured by hand-held range finder to ensure that the front and rear line of sight are equal in each station. For the forward and back measurements of each segment, ensure that the number of stations is even [8].

The errors in leveling measurement are mainly human error, instrument error and external condition error. In the horizontal line measurement in this paper, in order to eliminate the gross error and man-made operational error in time, to ensure the correctness and reliability of the observed high difference, the round-trip height difference comparison is performed for each measurement section, and the measurement of the round-trip measurement difference is performed. See in Table 1.

Table 1 Statistical table of the differential distribution of the precision level measurement

line name	total	$\lvert\Delta\rvert \leq 2$mm		$\lvert\Delta\rvert \leq 3$mm		$\lvert\Delta\rvert > 3$mm	
		quantity	%	quantity	%	quantity	%
M-N	26	24	92.3%	2	7.7%	0	0.0%
G-M	15	14	93.3%	0	0.0%	1	6.7%
M-Z	15	14	93.3%	1	6.7%	0	0.0%

∑	56	52	92.8%	3	5.3%	1	1.9%

The calculation formula for the accidental error based on the level of measurement per kilometer: $M_\Delta = \pm\sqrt{\frac{1}{4n}\left[\frac{\Delta\Delta}{R}\right]}$, See in the Table 2 for the statistical table of accidental errors in the measurement of the level of each kilometer.

Table 2 Statistical Table of Accuracy Errors in Leveling Measurements Per Kilometer

line name	distance(km)	Accidental error per kilometer M_Δ (mm)	remarks
M-N	41.94	0.45	
G-M	21.60	0.53	
M-Z	27.04	0.84	

6. Result analysis

In this paper, the Excel calculation table is used to calculate the compensating computation. The starting data is based on the result of the reference point SBM-13 (EL 816.630m), and the final elevation value is calculated from the average of the round-trip height difference. Compare the elevation values obtained this time with the elevation values provided by the owner, as shown in Table 3.

Table 3 Elevation results difference table

name	owners provide elevation results（m）	this measurement elevation（m）	difference（m）	remarks
TBM08	755.0848	755.0697	-0.0151	
TBM15	681.7450	681.7255	-0.0195	
TBM16	681.7631	681.7438	-0.0193	
TBM17	683.0494	683.0320	-0.0174	
GPS-4	837.1774	837.1654	-0.0120	
CBM05	645.9179	645.8930	-0.0249	
CBM06	639.8819	639.8584	-0.0235	
CBM12	635.1044	635.0788	-0.0256	
NJ305	682.9991	682.9554	-0.0437	
NBM03	698.5545	698.5387	-0.0158	
NBM34	1014.6707	1014.6972	0.0265	

It can be seen from the data in Table 3 that it can be seen from the difference value table that except for the difference of NJ305 of 43.7mm, the other differences are within 30mm, and the average value of the difference is 22.1mm, indicating that the entire leveling net is stable and reliable. The hydropower project can use this method to carry out precise elevation control network monitoring to ensure the safe construction and safe operation of water conservancy projects.

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References

[1] WANG L J, WU H Y, LUO T W. (2016) Research on Establishment Method of Construction Control Network for Jiayan Water Control Project.Water resources planning and design,152:1-5.

[2] HU Q T. (2018) GPS Height Measurement and Its Application in Hydraulic Surveying and Mapping Engineering.Heilongjiang Water Conservancy Science and Technology,34:173-175.

[3] YU S B. (2018) Effective Application Analysis of GPS Height Measurement Technology in Hydraulic Engineering Measurement.Scientific and technological innovation,10:134-135.

[4] WANG Z Y. (2018) Analysis of Error Sources and Control Methods in Precision Elevation Control Measurement Process of Water Conservancy and Hydropower Engineering.groundwater,05:230-231.

[5] JIAO G Z. (2018) Analysis of problems in the measurement of farmland water conservancy channel engineering.Scientific and technological innovation,24:126-127.

[6] SHUN C Y. (2018) Application of GPS Height Fitting in Hydraulic Engineering Measurement.Water resources planning and design,09:148-151.

[7] WANG D L, DIAO K. (2016) Application of digital photogrammetry system in hydraulic engineering measurement.Heilongjiang Water Conservancy Science and Technology,06:126-129.

[8] ZHANG L. (2016) Application of GPS Height Fitting in Hydraulic Engineering Control Network.Mapping and spatial geographic information,39:137-138.