Research on the Method of Measuring and Calculating the Cost of Temporary Protection Engineering Measures for Water and Soil Conservation in Substation

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Abstract: With the increase of relevant national standards and the public's awareness of environmental protection and environmental protection, more and more attention has been paid to water and soil conservation in substation projects. The investment in water and soil conservation measures has become one of the necessary components of the cost of substation projects. However, the current scientific calculation of the cost of water and soil conservation measures for substation projects lacks corresponding standards, which is not conducive to project cost control and investment benefits. Therefore, this paper takes the soil and water conservation measures of the temporary protection project of substation as an example. Based on the analysis of the current situation of the measure plan, firstly, the main factors affecting the investment of the temporary protection project of the substation are analyzed systematically; then the measures based on the linear regression analysis are constructed. Cost calculation model; finally, combined with empirical analysis, the validity of the model is verified.

1 INTRODUCTION

In the construction activities of substation projects, it is inevitable to occupy land and repair roads, which destroys the ground vegetation and stable terrain, and causes soil erosion problems. In order to solve the problem of water and soil erosion in the project, power grid companies need to implement corresponding water and soil conservation treatment plans during the construction of the project to ensure that the problem of water and soil erosion in the project is always controllable and under control.

Literature (Wang, Cai, Lei, Wang, 2021) takes the Xichuan Interchange (North) Link Road Project of Mianchi-Xichuan Expressway as an example to analyze the application and effectiveness of soil and water conservation measures in highway construction. Reference (Huang, Ou, Ye, 2021) combined with the current development of water and soil conservation work in power transmission and transformation projects, sorted out the problems in the calculation of related costs, studied and put forward suggestions on the development of water and soil conservation and cost management, which can improve the quality and efficiency of water and soil conservation. Literature (He 2021) combined with the characteristics of the plateau transmission line project construction, and based on the analysis of the relevant policy requirements for water and soil conservation, formulated corresponding water and soil conservation measures to support the development of the project's environmental protection work. Reference (Guo, Hu, 2021) combined with engineering construction examples, according to the actual situation of the project area and the characteristics of the project construction, divided the 500kV power grid improvement project prevention zone in the northwest of Shanxi Province, analyzed the characteristics of soil erosion that may be caused during the construction process, and proposed different prevention zones. The prevention and control measures of soil and water conservation have been implemented. In reference to the characteristics of power transmission and transformation projects and the hydrological and soil characteristics of the project area, the literature (He 2021) carried out soil erosion calculation and analysis based on related technical measures of water and soil conservation, and finally proposed the overall layout of water and soil conservation measures to achieve prevention and

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treatment of such projects. The goal of soil erosion within the scope of responsibility.

In summary, relevant scholars are currently paying great attention to the development of water and soil conservation in engineering construction and have conducted a lot of research on this. However, scholars focus more on the formulation of engineering water and soil conservation measures, and the related research on the cost of engineering water and soil conservation measures is relatively weak.

2 CURRENT STATUS OF SOIL AND WATER CONSERVATION MEASURES FOR TEMPORARY PROTECTION WORKS IN SUBSTATIONS

2.1 Analysis of Water and Soil Erosion Links in Substation Engineering

When the terrain of the substation is a hillside, after the project enters the site and clears the table, the slope shall be cut, that is, the hill excavation shall be carried out. Subsequent foundation excavation; when the terrain of the substation is on a plain, the foundation excavation will be carried out directly after the surface is cleared. Regardless of the situation, the original landform is subject to manual labor and drastic changes occur during the project. The vegetation on the ground is cleared, and colleagues excavate the earth and rock, resulting in a large amount of spoil.

The site is leveled before the foundation excavation, and the earthwork requires a lot of excavation, which usually accounts for more than half of the total excavation volume of the substation project. Part of it is backfilled, and the rest is used in projects such as roads outside the station. During the site leveling process, the soil loosens, and before the ground hardens, it is most likely to cause soil erosion.

In the construction process of the main building, the project that affects soil and water conservation is the construction land, which mainly includes the storage of temporary materials and waste, and the land occupation of equipment, but the area is small and only affects a small amount of land outside the station.

The road engineering and underground trench pipeline engineering in the station require a certain degree of excavation and filling. The road in the station first needs to level the land, and during the paving process, materials are transported in. The amount of excavation for cable trenches and water pipelines is relatively large.

2.2 Analysis of the Content of Temporary Protection Engineering Measures for Water and Soil Conservation in Substations

1) Topsoil stripping and temporary storage protection

According to the actual situation of the surface soil of the station area, it shall be stripped and stored in a centralized manner. The pile shall be stored in the station area as much as possible, and no new temporary land occupation shall be added. Since the storage time of surface soil is relatively long, generally during the entire construction period of the substation, the surface soil storage yard should be provided with temporary blocking, cover, drainage, and sand settlement measures. Blocks generally use soil-filled woven bags, color steel plates, etc.; thatch covers generally use dust-proof nets, geotextiles, etc.; temporary drainage is recommended for drainage ditches, generally earth (stone) ditching; sand settlement measures generally refer to construction of temporary sedimentation Pool.

2) Temporary protection of backfill soil storage

Pipeline construction for water supply, drainage, heating, communication, and cable trenches outside the station is generally excavated in sections, and filled with excavation. The excavated earth is generally piled along the line. The storage period and amount of soil are relatively small. Therefore, for this part Temporary piles of soil mainly take temporary blocking and covering measures. The earthwork used for backfilling the foundation of buildings or equipment and elevating the site shall be stored in a centralized manner, and measures shall be taken to temporarily block, cover, drain and settle the sand.

3)Temporary drainage and sedimentation of the construction site

The construction site is generally not hardened and uneven, and it is prone to hydraulic erosion during the construction process. Therefore, after the site is leveled, a temporary drainage ditch needs to be dug for drainage during the construction period. The wiring is consistent with the drainage measures in the permanent station. The temporary drainage ditch can be soil or brickwork. The structure has a temporary sand basin at the end, and the flood control design standard is determined according to the construction period.

4) Dust reduction on the construction site

In addition, during the construction process, water should be sprayed regularly to reduce dust and prevent wind erosion.

Table 1: Statistical table of temporary protection engineering measures for substations.

Serial number	Type of measure	Measure content
1	Filling woven bags	Stripped topsoil and earthwork excavated during construction,
2	Geotextile covering	Temporary blocking and covering during temporary stacking
3	Temporary drainage ditch	Mainly soil quality to meet the flow capacity

3 RESEARCH ON THE CALCULATION MODEL OF SOIL AND WATER CONSERVATION MEASURES BASED ON ONE-VARIABLE LINEAR REGRESSION ANALYSIS

3.1 Basic Theory of Regression Analysis Model

Regression Analysis refers to the use of statistical data to analyze the quantitative changes of various variables, and to reflect and describe this relationship in the form of regression equations. Regression analysis is divided into linear regression and nonlinear regression. This section only introduces the commonly used linear regression analysis. If there is only one independent variable involved in the regression analysis, it is a one-variable linear regression analysis, and the result obtained is a linear regression equation. The mathematical model of unary linear regression is:

$$y = ax + b \tag{1}$$

3.2 Regression Coefficient

The a in formula (1) is the regression coefficient, because the regression coefficient is the partial derivative of y with respect to x, so it is also called the partial regression coefficient.

The regression coefficient is a parameter that measures the degree of influence of the independent variable on the dependent variable. The larger the regression coefficient, the greater the degree of influence of the independent variable on the dependent variable. The positive and negative of the regression coefficient and the positive and negative meaning of the correlation coefficient are the same. The positive regression coefficient means that y increases with the increase of x, and the negative regression coefficient means that y decreases with the increase of x. According to the sample data, the least square method is used to find the optimal function by minimizing the sum of squares of the error, and the regression coefficient is obtained.

3.3 Research Steps

The steps to perform regression analysis on the factors affecting the cost of power transmission and transformation projects are as follows:

1) Determine the independent variable x in the regression equation, which is the influencing factor. The dependent variable y is the cost level. Collect sample data.

2) Estimate each parameter in the model under certain statistical fitting criteria, and get the regression equation.

3) Test the regression coefficients. Analyze the results.

The SPSS software can be used for linear regression analysis. Select the "Analysis"-"Regression"-"Linear" command. Input the independent variable and the dependent variable to get the regression coefficient table. The non-standard coefficients, standard coefficients, T statistics, significance, and 95% confidence intervals of non-standard coefficients are given in the table. Generally, significance is less than 0.3, and x can be regarded as having a significant effect on y.

3.4 Regression Model Construction

This paper selects 10 data samples of ZJ provincial power company, and constructs the model based on the actual cost of the project. The basic data of the sample is shown in the following table 2:

Table 2: Sample basic data sheet.

project name	Filling woven bag		Temporary water distribution ditch		Geotextile covering	
	Dosage (m^3)	Cost (Yuan)	Length (m)	Cost (Yuan)	Dosage (m^2)	Cost (Yuan)
project 1	300	32900	130	3050	120	1060
project 2	260	30600	150	3650	220	1562
project 3	250	31080	125	2825	350	2953
project 4	420	50060	260	6310	160	1080
project 5	120	10200	60	1300	180	1342
project 6	300	35120	180	5525	240	1849
project 7	200	26086	100	2600	450	3451
project 8	150	20950	86	1850	165	1285
project 9	280	36570	220	5200	145	1360
project 10	330	40240	315	8075	190	1420

Combining the basic principles of the model, the construction of a one-element linear regression model of water and soil conservation measures for substation engineering is shown in the following table:

Table 3: Cost calculation model for water and soil conservation measures.

Serial number	**Measure name**	**Cost estimation model**
1	Filling woven bags	$y = 120.25x - 5.2566$
2	Temporary water distribution ditch	$y = 26.163x - 215.53$
3	Geotextile covering	$y = 7.7981x + 5.014$

4 EMPIRICAL ANALYSIS

This paper takes a 500kV substation project in ZJ Province as an example to conduct an empirical analysis. Through the analysis of water and soil loss during the construction of substations and line projects, combined with the topography of the project area, the investment in water and soil conservation of the temporary protection project and the model prediction are shown in the following table 4:

Table 4: Water and soil conservation investment estimates for temporary protection works of the project.

Serial number	Project cost name	Unit	Quantity	Cost (Yuan)	Model prediction cost (Yuan)	Model calculation deviation rate (Absolute value, %)
1	Filling woven bags	3	255	30600	30658.49	0.19%
2	Temporary water distribution ditch	m	130	3250	3185.66	1.98%
3	Geotextile covering	2	1750	14000	13651.689	2.49%
Total measure cost		-	-	47850	47495.839	0.74%

It can be seen from the above table that the calculation deviation of the model is within 3%, indicating that the calculation accuracy of the model is high, and it can guide the reasonable cost control of the environmental protection measures of the substation project.

5 CONCLUSION

Based on the current situation of temporary engineering measures for soil and water conservation in substation engineering, this paper constructs a measure cost measurement method based on linear regression analysis, and analyzes the effectiveness of the model in combination with actual engineering cases. This method and model can provide support for the reasonable calculation of the cost of water and soil conservation measures for power grid companies and the improvement of the level of project cost control.

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