American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-11, Issue-07, pp-04-07
www.ajer.org
Research Paper Open Access

Cost control and management method of anti-slide pile reinforcing high and steep roadbed slope

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Abstract: *In view of the engineering conditions, natural environment and cost control factors in the construction of high and steep slope of Subgrade, the construction cost control system of anti-slide pile for slope reinforcement is established, which consists of five parts: reinforcement structure, environmental conditions, construction quality, technical level and organization management. The application of value coefficient method is subjective and neglects the importance of organization and management in Slope Stability and safety construction and cost control under complex engineering conditions and natural environment, even the prediction of the construction cost of anti-slide pile reinforcement slope will produce too big error, and can also optimize the construction technology, construction time, construction management control, at the same time, the main position of anti-slide pile reinforcement slope structure and organization management in the cost control is determined, which provides a useful reference for the cost control of high-steep slope treatment.*
Key words: *Slope engineering; anti-slide pile reinforcement; construction cost control;value Coefficient method*

Date of Submission: 26-06-2022 Date of acceptance: 08-07-2022

I. Introduction

Anti-slide pile is a kind of concrete structure, which can control the deformation of soil, enhance the stability of hidden soil, and make the soil self-bearing characteristics fully. Anti-slide pile is widely used in foundation engineering construction such as foundation pit, traffic slope, Mine Slope, etc. . It has played an important role in the field of engineering disaster prevention and mitigation. Especially in the treatment of high and steep slope landslide, it has shown obvious advantages. The anti-slide pile reinforcement scheme is one of the important parts of the high and steep slope reinforcement construction and cost control, and the cost control and the computation difficulty are also very big and so on characteristics, has become the side slope reinforcement smooth implementation barrier stone. Especially under complex geological conditions, weak or poor engineering geological conditions, the investment of this project will account for more than 80% of the total cost of slope engineering construction, so under complex environmental conditions, it is very important to control the cost of anti-slide pile in the construction of high and steep slope.

With the development of modern traffic, the demand of roadbed function is increasing, traffic engineering is increasing, large-scale rock and soil mass is high-filled and deep-dug, so the slope excavation is getting higher and steeper, the excavation space and the construction difficulty are getting bigger and bigger, at the same time, the influence of geological environment, surrounding conditions and natural climate on the safety and stability of slope is more and more intense, so the optimal selection of slope reinforcement is an important way to implement the environmental protection, energy saving and sustainable development of roadbed engineering. At present, the type selection of high-steep slope reinforcement is mainly based on the results of mechanical calculation, focusing on the overall stability of the reinforcement structure, low cost, construction convenience and other constraints to formulate the optimal design scheme, has accumulated a lot of experience. However, in the process of landslide treatment of high and steep slope, the majority of technical personnel still use experience to reinforce and select types, although the application of the experience method can make the slope safe and stable, however, the process of Slope Stability System Analysis and economic evaluation is not scientific and blind, and the subjectivity of stability evaluation and scheme selection is great, which will increase the construction cost and even induce landslide accidents. The main reason is that there is no in-depth comparative analysis on Technical Scheme Optimization, cost rationality and social impact, especially when the difference between reinforcement effect and construction cost is not large, it is more difficult to grasp the best design scheme accurately.

II. Software applied to the cost system of slope construction

2.1 Application of engineering measurement software

At present, in the construction process of slope reinforcement, the construction cost is mainly controlled by labor cost, material cost, construction machinery cost and construction subcontract cost. Because of its simple composition, clear goal, convenient calculation, single influence factor and easy operation, it has been widely used in the cost control of slope reinforcement. Cost software is based on the characteristics of the above-mentioned valuation and measurement of the development of applications. In the valuation process of slope reinforcement projects, engineers and technicians usually select cost software such as Guanglianda software, PKPM software, Le Clan des Siciliens software, cost master software, etc. , the three elements are directly input into the software system to obtain the construction price for cost analysis and control. In the whole process, the influence of Engineering Project, engineering environment, resource optimization and performance evaluation on cost is seldom considered.

Foundation pit engineering is a kind of compensatory foundation structure under the ground surface, which is the main structure of the building and also can be used as the basement space. The construction process of foundation pit engineering is influenced by geological conditions, surrounding environment, weather and other environmental factors, which are not only critical to the construction cost of foundation pit, but also to the control of the safety and stability of foundation pit, therefore, it is inevitable to put forward higher requirements for the contractor. Foundation pit engineering is also a kind of deep excavation soil structure, in support selection, precipitation, settlement control and other aspects of the requirements are also very high. At the same time, the technical implementation, process link, Scientific Organization and project management, also has a very important impact on the cost of foundation pit construction.

2.2 Construction cost system of anti-slide pile reinforcement slope

Slope Engineering is a kind of geotechnical structure existing in natural environment, which is the main structure of roadbed engineering and has many uses. In fact, the cost control of anti-slide pile reinforcement in the construction stage of high and steep slope is a complex system composed of multi-objectives and multi-elements, the construction cost is mainly affected by the slope structure, environmental conditions, construction quality, technical level and organizational management.

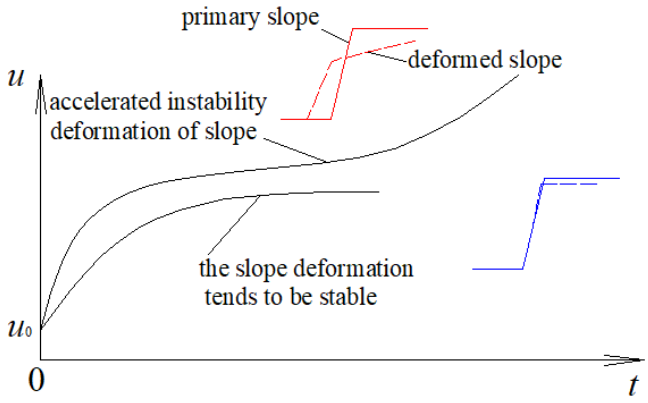

Figure 1. Fracture of slope soil

At the same time, the slope reinforcement construction has many procedures, strong technology, complex management, and the calculation results of different people are also more discrete, so the mechanical application of construction drawings, the construction cost predicted by experience is not accurate. Therefore, in the construction cost control of slope reinforcement, we must optimize the main control factors from the macro-level, then carry out the individual unit control from the micro-level, and combine the project practice to carry out the cost theory analysis, in order to effectively implement the rationality of cost control under the influence of multiple factors, and to make the construction of anti-slide pile slope project smoothly, we should fully master the construction of multi-factor cost control optimization system. All Things considered, the construction cost control system of anti-slide pile reinforcement, which is composed of five main control factors of slope structure, environment condition, construction quality, technical level, organization and management, and six cost individuals of labor cost, material cost, machinery cost, regulation cost, profit, tax and management cost, is determined. The construction cost structure chart of anti-slide pile reinforcement slope is shown in figure 2.

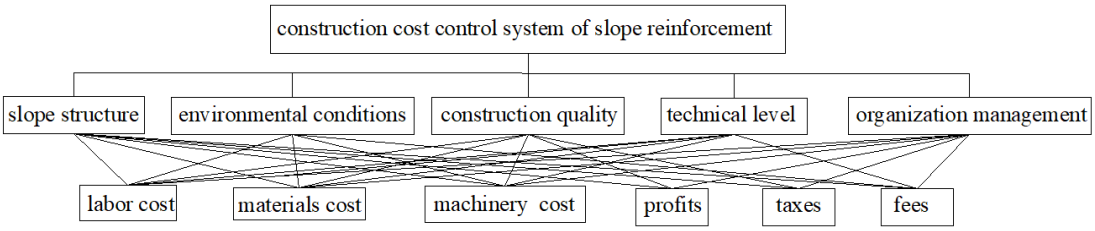

Figure 2.Construction cost structure chart of anti-slide pile reinforcement slope

III. Value Coefficient method of slope reinforcement cost

Value Engineering is one of the effective quantitative evaluation methods of technology and economy, and it can realize the expected effect of optimization and type selection of foundation pit support. The value is the ratio of function and cost and it can consider the best combination of technical and economic benefit, environmental benefit and social benefit in the optimization selection of foundation pit support. In the practice of foundation pit support, the application of value engineering in the selection of foundation pit type is usually controlled by the main factors, such as the stability of foundation pit, displacement deformation, engineering environment, construction period, construction cost, construction conditions in the pit, support effect and adjacent influence, etc. . In view of this, the whole stability, displacement and deformation, adjacent influence, support effect, construction period and environment influence can be taken as functions in the evaluation of Value Engineering Technology and economy. It has been proved by practice that the construction cost is positively related to the function in the foundation pit support, and it needs a certain cost to complete the predetermined function. In the early stage of the foundation pit support, the cost increases rapidly with the function requirement, while in the late stage of the construction, the cost increases slowly with the function perfection and the function exertion. After the function reaches the ideal state, the superposition trend line intersects the curve in the later stage of the construction, which is the most suitable point of the change rate of function and cost. Based on the theory of Value Analysis and considering the minimum construction cost, the following multi-objective optimization mathematical model is established to search the maximum value Coefficient of the primary scheme for the optimization scheme of anti-slide pile reinforcement of high and steep slope:

Objective function:

$$\text{Max: } V(a_i, q_i, f, F_i, C_i) \tag{1}$$

$$\text{Min: } C(x)$$

Constraints:

$$F(x_i) \geq [a_j] \tag{2}$$

Where $V(a_i, q_i, f, F_i, C_i)$ is the value coefficient, $C(x)$ is construction fees, $F(x_i)$ is constraints, $[a_j]$ is allowable value.

The value coefficient is a quantitative method of economic evaluation, which can fully consider the perfection of various functions in the system and optimize the allocation of system resources. The main steps of the technical and economic evaluation of the anti-slide pile strengthening high and steep slope are as follows:

(1) the function division of anti-slide pile reinforcing slope and the function requirements according to the influence factors of anti-slide pile reinforcing structure stability, the applicable conditions of supporting measures and social benefits; In the technical and economic evaluation of Value Engineering, the main functions are overall stability, displacement and deformation, adjacent influence, reinforcement effect, construction period and environmental impact. Among them, the functional requirements can be evaluated by experts using the pass method, according to the need for experts to evaluate the main functions can be divided into: a_i =10 分，9 分 •••••• 6 分.

(2) calculating the function important coefficient the function important coefficient is according to the system function composition characteristic and each function consummation and the display important degree. The function important Coefficient has the following stipulation: The most important is 1 mark, the unnecessary, redundant function is 0 mark. In slope reinforcement, several support schemes can be worked out first, and then the importance of each function can be scored by calculating the fault tree.

$$q(x_i) = b_i \quad (i=1, 2 \text{ •••••• } n) \tag{3}$$

Where $q(x_i)$ is function， b_i is score of functional importance， i is the number of divisions of a function.

(3) function evaluation score function evaluation score is the product of function requirement and function important coefficient, the evaluation result considers the influence of subjective and objective to function important coefficient, so that the optimization goal can reach the global search.

$$f(x_i) = q(x) \bullet a_i \quad (4)$$

(4) the functional Evaluation Coefficient is calculated as the ratio of the sum of the functional evaluation scores for each support programme to the total scores for each programme:

$$F(x_i) = \frac{f(x_i)}{\sum_{j=1}^{m} f(x_j)} \quad (5)$$

Where m is the number of anti-slide pile reinforcement program.

(5) calculation of a cost factor calculated as the ratio of the cost of each programme to the sum of the costs of each program

$$C(x_i) = \frac{c(x_i)}{\sum_{j=1}^{m} c(x_j)} \quad (6)$$

(6) calculating the Value Coefficient the value Coefficient is the ratio of the function evaluation Coefficient to the cost coefficient:

$$V(x_i) = \frac{F(x_i)}{C(x_i)} \quad (7)$$

According to the Value Coefficient theory, when the Value Coefficient is less than 1, the cost is too high and the function is surplus. In the scheme selection, the anti-slide pile reinforcement with the biggest value coefficient and reasonable cost is usually the optimal scheme.

IV. Conclusion

(1)through the deposit slip and construction process of the subgrade slope project, the construction cost control system of anti-slide pile reinforcing high and steep slope is established, which is composed of five parts: structure, environmental condition, construction quality, technical level and organization management.

(2) according to the main position of the Value Coefficient Foundation pit structure and the organization management in the cost control, the calculation result can guarantee the goal of advancing the schedule, reducing the cost and controlling the cost, it is more reasonable than the current single and experienced cost control method.

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Yanchao LI.A, et. al. "Cost control and management method of anti-slide pile reinforcing high and steep roadbed slope."*American Journal of Engineering Research (AJER)*, vol. 11(07), 2022, pp. 04-07.