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Study on cost calculation of mechanization construction in mountainous area

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Abstract. In order to speed up the implementation of power grid engineering mechanization construction, improve the mountain mechanization construction cost accounting and the existing construction technology, construction scheme and equipment selection and use of the matching degree, based on the analysis of the present situation of mechanized construction in mountainous areas, this paper discusses the problems in mountain transportation, foundation construction and road construction, this paper summarizes the principles and standards for calculating the construction cost of mechanization in mountain area, in order to improve the accuracy of cost calculation.

Keywords: Mountain; mechanized construction; cost accounting.

1. Introduction

The State Grid Corporation's notice on the publication of a three-year action plan for the “Six refinements and four modernizations” of infrastructure projects (No. 6 of State Grid Infrastructure [2022]) requires that “At the 2024 level, the rate of mechanized construction shall reach 80 percent, with emphasis on the application of mechanized construction techniques in such areas as foundation construction under complex terrain conditions, the improvement of the design guidance manual for mechanized construction, and the overall improvement of the level of mechanized construction.”. At present, due to topographical conditions, mechanical equipment and engineering materials can not be mechanically transported to towers in mountainous areas or mechanized construction can not be carried out in special terrain, therefore, at present mechanized construction is mainly applied to flat land, hills, river network and other terrain relatively flat terrain. With the development of split-type equipment and the popularization of new transportation modes, such as ropeway transportation and rail conveyor, the restriction of terrain on the application of mechanized construction is gradually weakening. In this paper, from the mountain transportation, foundation (Earth and stone) construction, construction road construction, channel cleaning, environmental protection and other aspects, combined with the particularity and complexity of mountain mechanization construction, this paper analyzes and studies the problem of calculating the construction cost of mechanization in mountainous area, improves the matching degree of the construction cost with the construction topography and the mechanization construction scheme, and promotes the implementation of the mechanization construction of power grid engineering.

2. The construction cost of mountain mechanization is listed

2.1 Mountain transportation

Material Transportation and equipment entry are the precondition of the mechanized construction of line engineering, and the rationality of the entry scheme will directly affect the feasibility and cost of the mechanized construction to a certain extent.

(1) If full-process mechanized construction is adopted, commercial concrete shall be used for the foundation concrete when the pumping conditions of commercial concrete are met, irrespective of the human transportation cost of concrete; if non-full-process mechanized construction is adopted, the mechanized construction tower can be poured by commercial mixing, and the non-mechanized construction tower can be poured by on-site mixing.

(2) Information price of cement, sand and stone using local materials. If the transportation distance of the construction site location exceeds the transportation distance of the local material information price, the transportation cost of the automobile exceeding part of the distance can be calculated.

(3) The quantity of transporting the surplus soil should be combined with the requirements of environmental protection and soil and water conservation, and the local balance should be given priority to, when manpower transportation is necessary, the 100m transportation distance shall be deducted from the earth-moving quota.

(4) During the construction and construction of cableway transportation overhead transmission line project, with the continuous improvement of construction mechanization, and compared with the traditional human and animal transport, ropeway transportation has many advantages, such as adapting to complex terrain, shortening transportation distance and improving transportation efficiency.

2.2 Foundation works

1.The principle of calculating the cost of micro-pile foundation

The micro-pile foundation mainly refers to the foundation with the diameter of 300-400mm, which is composed of the reinforced concrete micro-pile formed by the pouring of fine stone concrete and the pile cap connected at the top of the pile, the utility model can be applied to the transmission line foundation engineering under the rock geological condition in the mountain area, and has a wide range of application. It has the following advantages: the diameter of the foundation is suitable, the bearing capacity of the single pile is higher than that of the anchor pile, and the application range is wide; It can meet the needs of foundation selection for overburden layer, soft rock and broken rock foundation of about 4m~10m, adopting micro-pore-forming machine, it can be well adapted to different topography, with low safety risk, fast pore-forming speed and high mechanization degree. The minimum pore size of mechanical excavation of transmission line foundation is less than 1m, which is much smaller than that of micro-pile. In the pilot implementation of ultra-high pressure engineering, relying on engineering specifically for engineering-related issues, listing principles as Table 1.

Table 1.Adjustment principle of micro-pile quota

Quota number	Name of quota	Unit	Artificial	Materials	Mechanical	Total
YX2-195	Ordinary soil, hard soil, hole diameter less than 1m, hole depth more than 6m	m	125.26	2.57	237.53	365.36
YX2-195t	Micro-pile foundation mechanical excavation of ordinary soil, hard soil, pore size 0.4 m	m	125.26×0.31=39	2.57	109.05	150.62
	Adjustment factor		0.31	1	0.46	
YX2-207	Loose gravel, pore size less than 1m	m	182.15	2.58	499.25	683.98
YX2-207t	The micro-pile foundation is mechanically excavated with a diameter of 0.4 m	m	39	2.58	231.19	272.77
	Adjustment factor		0.21	1	0.46	
YX2-207t	Micro-pile foundation mechanical excavation square rock, diameter 0.4 m	m	58.5	3.87	346.785	409.155
	Adjustment factor		1.5	1.5	1.5	

2. According to the principle of calculating the cost of mechanical excavation, the selection of drilling equipment for excavation foundation should be matched according to the equipment entry condition, stratum lithology and drilling capacity of the equipment, for artificial backfill of clay, loess, silt and non-gravel foundations, mechanical Luoyang shovels may be used; For common soil, hard soil, pebble layer and strong weathered-fully weathered rock foundation with saturated uniaxial compressive strength under 40 mpa, rotary drilling machine can be used, water mill drilling can be used. Compared with the 2013 transmission line budget quota, the 2018 transmission line budget quota distinguishes manual excavation from mechanical excavation, and the manual excavation of rock and soil distinguishes rock blasting from manual excavation, excavating Foundation machinery excavates the square according to the ordinary soil, the hard soil, the loose sand and gravel classification establishment quota. In the 2018 transmission line budget quota, the maximum use of the basic excavating machinery and equipment to crawler rotary drilling rig, encountered hard rock, there is drilling immovable situation, thus greatly reducing the construction efficiency leads to increased construction costs. Therefore, the 2023 quota station combined with the actual application of mechanical excavation of rock and soil technology to produce a supplementary quota-excavation foundation of rock and soil mechanical excavation. State grid electric rating [2023] No. 33 notice of 13 enterprise pricing basis for partial discharge test of cable, etc. . The cost of excavating foundation

rock and soil machinery includes site leveling, tools in position, abdication, drilling (expanding) hole, removing (cleaning) slag, cleaning site, tools and tools transportation, etc. . Among them, the fixed mechanical shift increases the unit price of electric construction drilling rig.

3.Integrated Intelligent Machine for deep foundation pit operation

In order to improve the mechanization degree of manual excavation pile foundation construction, increase the safety of earthwork construction workers, and improve the accuracy of harmful gas monitoring in foundation pit, in December, the State Grid Corporation's electricity construction quota 2023 issued an additional quota for integrated deep foundation pit intelligent machines. The additional quota belongs to the machinery shift quota, and this machine belongs to the category of vertical transportation machinery, the utility model is an integrated device with the functions of deep foundation pit gas monitoring, earth excavation and vertical transportation.

If the intelligent machine is used in the project, the mechanical shift should be adjusted and replaced to improve the accuracy of the cost.

4.Construction Road construction

Construction roads usually use existing roads for transportation to the maximum extent possible, minimizing the occupation of arable land, reducing the destruction of vegetation and reducing soil erosion. The existing construction forms have road bed shaping, road widening, paving gravel, paving steel plate, etc. . Considering the width of all kinds of machinery and reducing the cost of investment, the width of temporary road construction should take the entry condition of basic mechanization construction equipment as the boundary. Among them, the thickness of laying gravel generally not more than 15 cm. According to the statistics of all kinds of construction road construction forms in the near future, among them, the quota of“Road bed shaping” and“Road base” should be applied to the road bed shaping and the crushed stone paving, and the cost of unvalued materials such as crushed stone should be increased, the bed shaping is about 50,000-80,000 yuan/km, and the newly built gravel road is about 250,000-300,000 yuan/km (not including the transportation distance of gravel car) . The steel plate laying is usually done by lease. When purchasing, the amount of amortization, the number of days and the number of times of amortization (4-6 times) should be considered, the unit price of leasing and disassembly transfer may refer to the local construction quota station price standards. At the same time, consideration should be given to the costs of environmental protection measures and compensation for trees, young seedlings and Cash crop on the construction roads, depending on the length of the road.

5.Channel cleanup

(1) there is no compensation fee for seedlings in mountainous areas. Photos should be provided if necessary.

(2) compensation fees for forest land and trees occupied by the tower base shall be calculated on the basis of actual tree species, tree diameter and spacing on site, and shall be calculated according to the standards of relevant local government documents. The charge for the preparation of the feasibility study report of woodland and the cost of vegetation restoration should be considered. According to the guiding opinions on the charging of forestry industry survey and planning projects -LRB-documNo. no. 15 oCJCCcjcc 2018]) , the charge for the preparation of the feasibility report on the use of forest land shall be calculated according to the two types of land-block and land-line. The fee for the preparation of the forest land feasibility report = the base fee + the base price × the physical workload (the total area of the forest land used within the area of the block land or the total length of the linear land used) × the adjustment coefficient. A report on the feasibility of using forestland prepared a base price table for fees according to the shape of the forestland used, as shown in Table 2:

Table 2.Rates of Prepare the feasibility report of using forest land

The shape of the woodland	Basic expenses	Charge base price
Block land	50,000 RMB/project	15,000 RMB per hectare
Linear land	50,000 RMB/project	15,000-20,000 RMB per hectare

According to article 30 of the"Guidance on the charge of forestry industry survey and planning projects", the compilation of the feasibility report on the use of forest land for construction projects should embody the principle of high quality and high price, the specific range of high quality and high price shall be determined by both parties through consultation on the basis of the prescribed fee standard. At present, in the projects that have been implemented in Henan province, when the path length is long, the expenses for preparing the feasibility report of using forest land are determined through consultation, the cost is about $8,500-$9,000 per kilometre (500 kv pumped-out works for Luoning County long and 500 kv pumped-out works for Heaven Lake Nanyang) , and according to the actual situation to adjust, but in principle can not exceed the"Forestry industry survey and Planning Project FEE guidance" in the charging standards. When overhead power lines are located in forest areas, in addition to compensation for trees in accordance with government documents, but also in accordance with the provisions to restore vegetation and forestry production conditions. November 29,2021, the Henan Forestry Bureau issued a circular of the Henan Forestry Bureau on the publication of the standards for the restoration of vegetation and forestry production conditions and the replanting of trees in Henan province (for trial implementation) , specifying the scope of application of the standards, the standards for the restoration of vegetation and forestry production conditions, the requirements for the process and quality standards for the restoration of forestry production conditions, the standards for the replanting of trees, the standards for the cost of replanting, and the relevant regulations for the organization and acceptance.

The standards for collecting fees for restoring the conditions of forestry production are as follows: 1) for arbor forest land with canopy density of more than 0.2(including cutting and burning areas) , bamboo forest land and nursery land, the levy shall be 10 yuan per square metre; for shrub forest land, sparse forest land and unestablished afforestation land, the levy shall be 6 yuan per square metre; for suitable forest land, the levy shall be 3 yuan per square metre; 2) for state and provincial public welfare forest land, the Levy shall be 2 times as prescribed in subparagraphs 1) ; 3) for forest land in urban planning areas, the Levy shall be 2 times as prescribed in subparagraphs 1) and 2) ; 4) for forest land outside urban planning areas, different levy standards shall be applied according to the nature of construction projects for acquiring forest land, and the levy rates shall be levied according to subparagraphs 1) and 2) for public infrastructure, public utilities and national defense construction projects; and for commercial construction projects, the levy rates shall be 2 times as prescribed in subparagraphs 1) and 2) . Power grid projects are public infrastructure construction projects, in accordance with the provisions of subparagraphs 1) , 2) Levy Standard Levy. (4) the compensation fees for trees due to the construction of temporary roads should be counted separately and calculated on the basis of the actual tree species, tree diameter and spacing on site, and the relevant local government documents.

3. Conclusion

In this paper, from the mountain transportation, foundation (Earth and stone) construction, construction road construction, channel cleaning, environmental protection and other aspects, combined with the particularity and complexity of mountain mechanization construction, this paper analyzes and studies the problem of calculating the construction cost of mechanization in mountainous area, and gives the corresponding standards. With the renewal of construction technology and the continuous iteration of construction equipment, more safe, advanced and reasonable construction means will gradually replace the existing construction plan, technical and

economic professionals need to keep pace with the times, through improving the relevant quota or listing standards to make the cost and technology more matching to promote the development of mechanized construction.

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