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# Research on the application of wheel pile foundation for transmission lines

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### ABSTRACT

Under the action of low pressure, the wheel pile foundation bears most or even all the downward pressure. When the wheel pile foundation is subjected to uplift force, the uplift force is supported by the short pile, and the ring frame and the 4 flange mainly play the role of transfer pulling force, while the main bearing force is short and short pile. When the wheel pile foundation is subjected to horizontal forces, the horizontal force is mainly borne by the flange and the ring frame. Therefore, only downward pressure and horizontal force should be considered for the ring frame and flange, while uplift force should be considered for the design of thin and short piles. The basic design is simple and the transmission path is clear. The ring frame, flange and short pile of the wheel pile foundation are prefabricated. The foundation can take different prefabricated installation methods with the mechanized construction conditions. It can not only guarantee the quality of the concrete slab, but also speed up the construction speed of the foundation. By comparing with the economic technology of the plate foundation, it is found that under the same geological conditions, the use of wheel pile foundation can reduce the concrete earthwork and the increase of the load, the decrease of concrete is also increased, and the amount of steel is saved, and the economic benefit is remarkable.

**Keywords:** Transmission line; New type of wheel pile foundation; Horizontal force; Uplift force

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## 1. The necessity of the research on the new type of wheel pile foundation

The investment scale of national Power Grid Corp power grid continues to increase, and the construction of power grid is in the key stage from ultra high voltage power grid to UHV power grid and from traditional power grid to smart grid. The construction of power grid is difficult, time tight, heavy task, high pressure of safety construction, and increasing environmental protection requirements. Stream technology, first-class design, first-class construction, first-class management, to promote the construction of world-class power grid has become a key proposition in the current environment. Wang Yonghua only studied the application of the conventional assembly foundation in desert area, and got the superiority of the assembly foundation<sup>[1]</sup>, But there is no research on the new assembly base. Chen Zaiqian analyzed the bending force of miniature steel pipe pile, and summed up the expression of bending moment through analysis<sup>[2]</sup>, Su Rongzhen studied the uplift test of micropiles and towers. It is concluded that the coefficient of resistance to pile groups is 0.7<sup>[3]</sup>. The above analysis is the mechanics research on the existing foundation, and the new foundation is not put forward and the research is carried out. In this paper, the new foundation is put forward first, and the new concept is studied and analyzed on the basis of the new concept. For a long time, due to the constraints of research force, cost input and other factors, and the influence of traditional consciousness, artificial investment in power grid construction, construction machinery research and development and investment are insufficient, the lack of efficient and special construction machinery. Operators have high labor intensity, low efficiency, long construction cycle and high operational risk. Some construction methods fail to fully consider the requirements of environmental protection. The traditional construction mode of "manpower based and mechanical auxiliary" will be unsustainable,

popularize the mechanized construction of the whole process of transmission line, construct the standardized configuration scheme of the whole process mechanized construction equipment, develop and configure the efficient construction equipment according to the plan, and adapt the function and model of the construction equipment according to the actual engineering demand, so as to adapt to the construction. It is an important way to ensure the scientific, safe and high speed development of the power grid project to realize the serialization, standardization and standardization of the construction machinery and equipment products with different environment and different terrain conditions. The development of the new foundation is bound to be the inevitable requirement of mechanized construction. Wheel pile foundation has good generality, strong practicability and strong bearing capacity. It is suitable for the whole process of mechanized construction. The whole process mechanized construction is a new model of engineering construction, which requires the whole process and the cooperation of all the majors to form a series of technical achievements in the aspects of engineering design, special equipment, construction methods and technical specifications, so as to support the construction of power grid engineering, meet the demand of the large scale construction of the electric network of the company, ensure the safety, and ensure the safety, High quality and efficient completion of the power grid construction task, promote the construction of "construction management, professional and technical" construction enterprises, speed up the cultivation of scientific and technological innovation personnel for construction equipment, and fully grasp the core competitiveness of the development of construction technology, continuous innovation and so on. The whole process mechanized construction changed the traditional construction mode, effectively solved the shortage of manpower and the rise of labor cost,

alleviated the labor intensity of the construction personnel, conformed to the international trend of development, improved the mechanization rate, embody the people-oriented and promoted the core competitiveness of the construction enterprises. Therefore, wheeled pile foundation meets the requirements of mechanized construction, and the stress and deformation in all directions are good, which meets the requirements of safety and economy.

## 2. The Research on the structure of a new type of wheel pile foundation

In order to analyze the innovation and adaptability of the new wheel pile foundation, it is necessary to explain the components of the wheel pile foundation. The pile foundation is made up of precast ring frame, 4 flanges and segmented fine short piles. The foundation ring frame and flange are mainly subjected to the downward pressure horizontal force, and the foundation short and short piles mainly bear uplift force. The load transfer of the wheel pile foundation is clear and the bearing capacity of the foundation is easy to analyze. The concrete composition is shown in Figure 1.

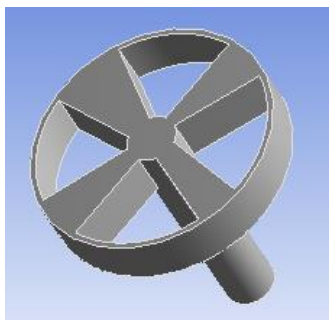


FIGURE 1. Wheel pile foundation

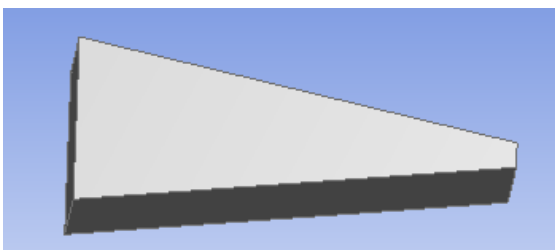


FIGURE 2. Prefabricated flange

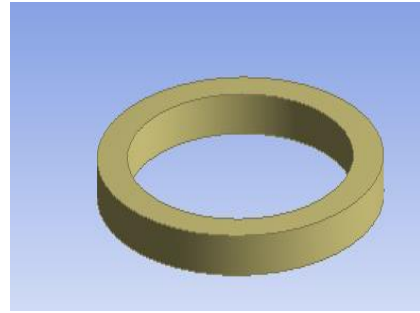


FIGURE 3. Prefabricated ring frame

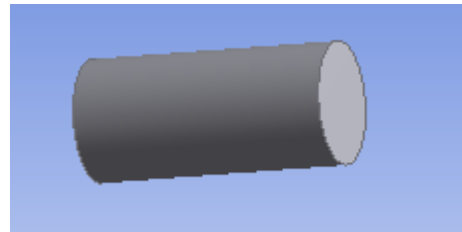
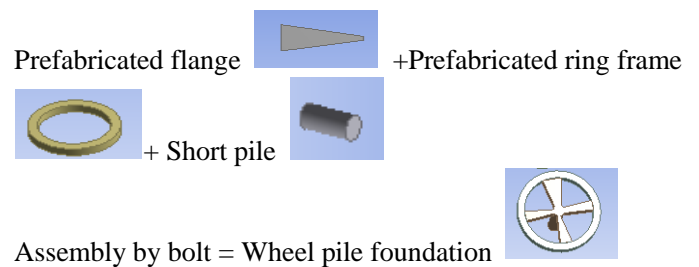


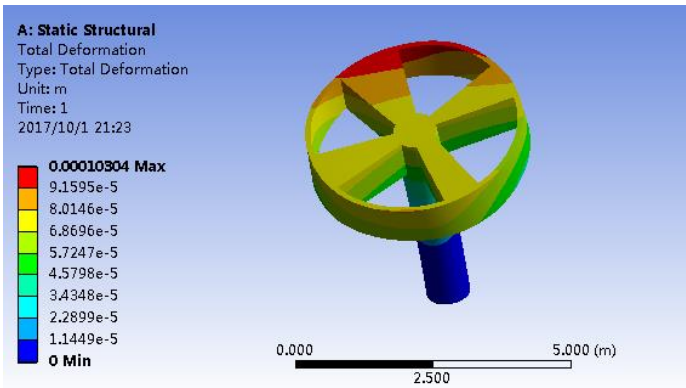
FIGURE 4. Short pile



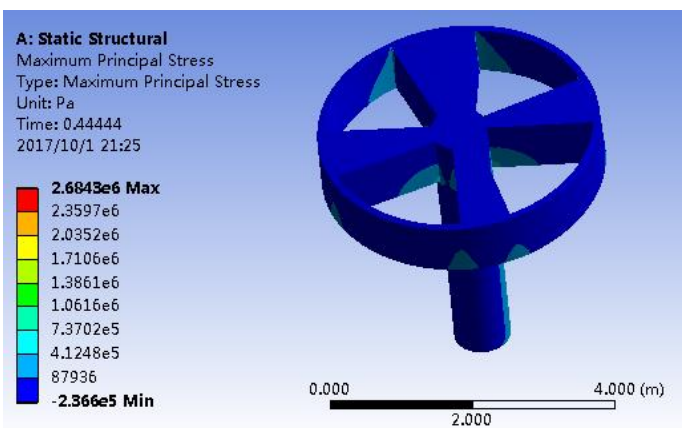
## 3. Stress analysis of wheel pile foundation

The present analysis of the mechanical characteristics of the wheel pile foundation is based on the strain of the 5 wheel pile foundation: the concrete change of the strain is shown as the maximum displacement in the relative side, mainly through the ring frame to resist overturning, the maximum lateral displacement is 0.0916mm, the minimum lateral displacement is 0.0145mm, the overall stress is more stable, and the anti overturning ability is good.

As shown in Fig. 6 stress diagram, the inner side of the ring frame and the side of the pile have greater force, the maximum stress is 2.35MPa, the overall force is better, and the pullout performance is excellent.



**FIGURE 5.** Wheel pile foundation strain diagram



**FIGURE 6.** Maximum stress of wheel pile foundation

#### 4. Construction plan

The ring frame can be divided into four parts in the factory, and the 4 parts of the flange are also divided into 4 parts in the factory, and the short and thin piles are assembled according to the actual situation according to the load and geological condition of the tower.

The connection is connected by the ring frame and the bottom of the flange through the bolt, the top of the flange and the short pile are connected through the bolt, and the short and fine piles and the 4 ring frames have holes in the factory in order to apply the reinforcing bar to the short and thin piles and the ring frame to apply the prestress through the flange. The bolt is connected. After the completion of the wheel-pile foundation, the high pressure grouting measures are adopted in each part, which is beneficial to the reinforcement of the foundation

and is more conducive to the solution of the Anticorrosion Scheme.

#### 5. Application conditions of wheel pile foundation

Only the upper ring frame and the flange are excavated, while the lower short and thin piles make full use of the advantages of the undisturbed soil such as large bearing capacity and strong deformation resistance. For most of the design conditions are applicable to the design of anti pull-out and anti overturning control, the geological conditions are suitable for hard plastic, plastic and other conditions, and the groundwater should not be too high. Generally, the depth of groundwater is above 2 meters.

#### 6. Conclusions

(1) When the wheel pile foundation is subjected to the downward pressure, the plate is subjected to most or even under pressure. When the wheel pile foundation is subjected to uplift force, the uplift force is supported by the short pile, and the ring frame and the 4 flange mainly play the role of transfer pulling force, while the main bearing force is short and short pile. When the wheel pile foundation is subjected to horizontal forces, the horizontal force is mainly borne by the flange and the ring frame. Therefore, only downward pressure and horizontal force should be considered for the ring frame and flange, while uplift force should be considered for the design of thin and short piles. The basic design is simple and the transmission path is clear.

(2) The ring frame, flange and short pile of the wheel pile foundation are prefabricated. The foundation can take different prefabricated installation methods with the mechanized construction conditions. It can not only guarantee the quality of the concrete slab, but also speed up the construction speed of the foundation.

(3) By comparing with the economic technology on the basis of the plate foundation, it is found

that under the same geological conditions, the use of wheel pile foundation can reduce the concrete earthwork more than 20%. With the increase of load, the reduction of concrete is also increased correspondingly, and the amount of steel is saved by about 40%, and the economic benefit is obvious.

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