Research on the Electric Lifting of the Corner Transmission Tower

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Abstract. By establishing the finite element model, the reliability of the corner transmission tower is analyzed before and after jacking. The calculation conditions are divided into four types: self-weight working condition before jacking of electric tower, wind load working condition before jacking, self-weight working condition after jacking, and wind load working condition after jacking. The results have been compared and analyzed by analyzing and calculating model and internal force of each working condition. The results show that there is not much deviation between the unit stress and the internal force bending moment of the key parts, which meets the normal use requirements. Under the wind load conditions of the transmission tower, the stress of the tower tower increases, but it is not obvious, which shows that the charging jacking technology of the corner transmission tower is safe and reliable.

1. Introduction

With the growth of the national economy, the state's investment in urban and rural construction has also been increasing, and, and it will causes some changes in the mountainous terrain in the process of urban and rural construction, thus affecting the original transmission tower. For example, the filling will cause the foundation of the tower and the lower part of the landfill, and the excavation will cause the water to corrode the foundation of the tower and cause the tower to be unstable. On the other hand, due to the needs of municipal engineering, the project has to cross the high-voltage transmission line between the towers, and the safety distance from the transmission line is insufficient. At present, the solution to such problems is generally to re-select the tower position, redo the foundation, and rebuild the new tower to replace the old tower. This method is not only costly but also requires power outages for the tower. In extreme cases, it may require a total station blackout. This will directly affect the power supply of the grid, causing huge economic losses and creating some security risks. The jack-up transmission tower can effectively solve the above problems, which greatly saves the cost, but at the same time, the jacking technology also has some safety hazards [1-3]. Therefore, it is necessary to carry out a scientific static analysis of the jacking angle electric tower.

In this paper, a corner transmission tower is taken as the research object, and the finite element analysis software Midas is used to model and analyze the law to find out the law before and after the electrification of the corner transmission tower [4].
2. Establishment of finite element model

2.1. Model establishment
The basic steps are as follows [5-7]:

- Determine the coordinates of the key points of the transmission tower.
- Define the parameters and material properties of each unit in the transmission tower.
- Connect the key points into lines and determine the unit properties of the line.

In this paper, the truss hybrid model is used to establish the finite element model of the corner transmission tower in Midas. The main material of the tower, the transverse steel and the oblique steel are selected by the beam unit, and four iron feet at the bottom of the tower and four supports at the bottom of the tower after lifting were selected as boundary conditions [8-9], and the tower model before jacking is shown in Figure 2, and tower model after jacking is shown in Figure 3.

2.2. Working conditions
Since the purpose of the calculation is only to consider the safety of the tower before and after the lifting of the tower and the change of stress and displacement, only the self-weight and static wind load of the structure are considered, regardless of the temperature effect. Because the corner tower is lifted as a whole, the influence of uneven settlement of each iron foot can also be ignored. It is divided into the following four working conditions:

- Working condition 1: self-weight before jacking.
- Working condition 2: wind load before jacking.
- Working condition 3: self-weight after jacking.
- Working condition 4: wind load after jacking.
  According to load code for the design of building structures [10], the wind load is calculated as follows:

\[ W_k = \beta z \mu_s \mu_z W_0 \]

- \( W_k \) is the standard value of wind load (KN/m²);
- \( \beta_z \) is the wind vibration coefficient at height \( z \);
- \( \mu_s \) is the coefficient of shape of wind load;
- \( \mu_z \) is the coefficient of variation of wind pressure height;
- \( W_0 \) is the coefficient of variation of wind pressure height.

The wind load standard value calculation results are as follows, and a line load is applied to the finite element model based on the calculated wind load standard value.

| Table 1. Before Jacking |
|-------------------------|
| Hight z (m) | 0 | 7.5 | 13.5 | 19.5 | 26 | 33 | 39.5 | 46 | 49 |
| \( W_k \) (KN/m²) | 0 | 2.08 | 2.54 | 2.56 | 2.76 | 2.95 | 3.16 | 3.27 | 3.37 |

| Table 2. After Jacking |
|-------------------------|
| Hight z (m) | 0 | 3 | 10.5 | 16.5 | 22.5 | 29 | 36 | 42.5 | 49 | 52 |
| \( W_k \) (KN/m²) | 0 | 2.08 | 2.08 | 2.35 | 2.64 | 2.85 | 3.04 | 3.2 | 3.35 | 3.41 |

### 3. Analysis results

As shown in the calculation results in Figure 4 to Figure 7, it can be concluded that the force change before and after the jacking of the corner transmission tower is small, indicating the reliability of the electrification jacking method.

![Figure 4](image1.png)

**Figure 4.** The stress cloud and internal force cloud of working condition 1.

![Figure 5](image2.png)

**Figure 5.** The stress cloud and internal force cloud of working condition 2.
4. Conclusion
(1) Under the conditions of the top and bottom of the corner transmission tower, the unit stress and internal force do not change much, and meet the normal use requirements. Under the wind load after the jacking, the internal force of the tower angle is larger than the ceiling, but the change is not especially obvious.

(2) Through the comparative analysis of various working conditions, it is shown that the front and rear corner transmission towers are safe, indicating that the charging jacking construction method is safe and reliable.

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