Research on the Method of Wire Impact Suspension Type Spanning Frame

N Jia, Y J Xia, J C Wan and Y S Hu
China Electric Power Research Institute, Beijing 100055, China
Email: 286488316@qq.com

Abstract. With the intensive construction of the UHV DC transmission project, the hidden dangers of the wire running line impacting the suspension type spanning frame are gradually increasing, and the dynamics of the wire-to-suspension type spanning frame is rarely studied in depth. In this paper, the dynamic response of the wire to the suspension type span at different heights is studied. It is concluded that as the height of the wire increases, the value of the main stress received by the wire rope is gradually increased when the net is hit. The greater the vibration that the net is subjected to, the slower the main stress of the netting rope decays with time.

1. Introduction
With the intensive construction of UHV DC transmission projects, tension line crossing construction has become increasingly frequent. In order to protect the tension line from crossing the span in the construction, it is generally adopted to erect the span. Because the suspension type spanning frame is easy to be widely used in the construction of the cross-over power line, the hidden danger of the wire running line impacting the suspension type span is gradually increasing, and the dynamics of the wire to the suspension type spanning frame is increased. Few people have studied it in depth. This paper relies on the Yongtai Tafeng (Blue Mountain)-Chuzhou Linwu 220kV line construction P124#~P124# section to cross the high-speed rail project, and study the dynamic response of the cable to the suspension type span at different heights.

2. Suspension Spanning Frame Introduction
Suspension type spanning frame, also known as no-crossing frame system, refers to the provision of temporary beams or cords as support devices on the towers at both ends of the spanning gear, installing load-bearing cables between the supporting devices and laying insulated nets and installing insulating struts Protect the safety of the crossed objects. It is mainly composed of supporting devices, bearing cables and sealing devices, and has the advantages of long distance span, simple structure, convenient installation and small construction difficulty. The basic technical parameters of this project are shown in Table 1, and the construction layout is shown in Figure 1[1].
3. Dynamic Modeling of Wire and Suspension Crossing System

3.1. Simulation Model Creation and Simplification

For the dynamic response of the suspension type cross-frame under the dynamic impact of the wire, in order to improve the calculation efficiency without reducing the calculation accuracy, the wire and the suspension type span are established in the dynamic modeling. Two-dimensional line model. In the unit selection process, the two-dimensional line model has two unit types to choose from, one is the truss bar unit and the other is the beam unit.[2] One node of the truss bar unit has two degrees of freedom, corresponding to only the axial tensile force, and the tensile stress of the node is decomposed into two components; one node of the beam element has three degrees of freedom, corresponding to the axial pull Pressure and bending moment, the force exerted by the node has three components; the difference between the two is that the beam element can withstand the bending moment, and each node has one more degree of freedom of rotation, and the rod unit cannot bear the bending moment. Since the wire and the rope are flexible and cannot bear the lateral bending moment, the truss bar unit is selected for dispersion during the unit selection process. [3][4]The global simulation model established with reference to the construction site layout is shown in Figure 2. Because this paper only cares about the dynamic response of the wire to the suspension type span frame, the simplified simulation model can be simplified as shown in Figure 3.
3.2. Loading Method and Boundary Conditions
As shown in Figure 4, the gravitational field loading of the wire is achieved by applying a vertical downward gravitational acceleration of 9.8 m/s2 to the wire. A hinge constraint is applied to the right end of the wire, and a fixed constraint is placed at both ends of the suspension type span. A universal contact is provided between the wire and the suspension type span, which has both normal contact force and tangential friction force.[5]

3.3. Working Conditions of Wire Impact Spanning Frames at Different Heights
In order to study the dynamic response of the wire to the suspension type span frame, five kinds of working conditions, namely the height of the cable-stayed spanning frame, are 10m, 15m, 20m, 25m and 30m, respectively, to study different heights and suspension spans. The relationship between the dynamic response of the frame.
The numerical simulation analysis is carried out by using the wire to impact the right sealing net. When the wire impacts the suspension type span at different heights of 10m, 15m, 20m, 25m and 30m, the maximum principal stresses at the moment of contact are 5.02MPa, 5.615MPa (As shown in Figure 6), 7.249MPa, 8.548MPa and 9.324MPa.

By analyzing the main stress value of the sealing net on the right side of the suspension cable to the right side of the suspension frame from the moment of impact to 0.6s, as shown in Figure 7, it can be seen that as the height of the wire increases, the impact of the sealing net At the moment, the value of the main stress received by the sealing rope is gradually increased. The higher the height of the wire impact sealing net, the greater the vibration of the sealing net, and the slower the main stress of the sealing net decays with time.

**Figure 5.** Positional relationship between wires and suspension type spans at different heights 
Numerical simulation calculation result
4. Conclusion
Through the analysis of the simulation results, the following main conclusions are drawn.

(1) As the height of the wire increases, the value of the main stress received by the wire rope is gradually increased when the net is hit.

(2) The higher the height of the wire impact sealing net, the greater the vibration of the sealing net, and the slower the main stress of the sealing net decays with time.

5. Acknowledgments
This Research was supported by Science and Technology Research Project of State Grid (Research on Key Techniques for Improving Impact Resistance of Suspension Bridges.GCB17201800075)
6. References

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