Shaking table test on the failure of OLF1000 considering the dynamic coupling effect of transmission lines

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Abstract

Earthquake damage data [1, 2] show that even if electric power facilities and transmission towers suffered serious damages, long-span truss structures (LSTSs) in substations remained intact under many strong earthquakes. These phenomena could be due to the influence of the dynamic coupling effect (DCE) of transmission lines on the seismic response of LSTSs, which is a matter of concern. There are two parts of prior related work including (i) node analysis, structure optimization and conventional dynamic analysis on LSTSs without regard for the DCE, and (ii) dynamic analysis of tower-line system consisting of numerical study in which transmission lines were modelled by cable elements, and shaking table test in which the steel chains were used to simulate transmission lines. This study addresses shaking table test on the failure of 1000kV outgoing line frame (OLF1000, a type of LSTSs) considering the DCE of transmission lines, simulated by massless springs with equivalent dynamic stiffness which accounts for geometric features, material properties and dynamic and damping characteristics of cables.

The OLF1000 model and suspension system model are designed and processed with the scale factor of 1/15, shown in Fig. 1. Transverse excitation is implemented with the typical TAFT record. And the numerical reconstruction analysis is launched after arranged experiments. The test results indicate that (i) the DCE substantially weakened the seismic response of the OLF1000, (ii) damages of the OLF1000 started from the middle of columns and its collapse happened when the OLF1000 overturned from the very first damaged region to the suspended side, which is consistent with numerical analysis, and (iii) the OLF1000 did not collapse even PGA = 2.2 g, which is closely related to the DCE. Accordingly, it is of great significance for accurate assessments of seismic performance and achievements of economical design by considering the DCE of transmission lines in the seismic design of LSTSs in substations.

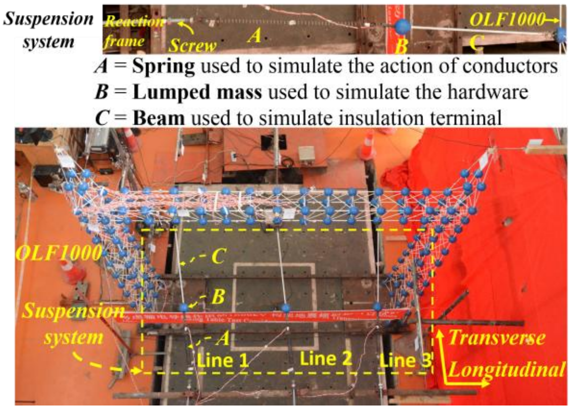

Fig. 1 Test model

References

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