

学术论文

输电塔架与输电塔-线耦联体系风振响应风洞试验研究

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摘要: 为研究高压输电塔-线耦联体系与输电塔架的风振动力响应特点,以某典型500kV高压输电线路结构为原型,设计制作了单塔与塔-线体系的完全气弹模型,进行了多个风向角、多级风速下的单塔和塔-线体系在紊流风场中的完全气弹模型风洞试验。试验结果表明:在紊流风场中,输电塔结构的顺风向响应和横风向响应处于同一数量级,塔-线体系与单塔相比,其风致敏感性增强,塔-线模型中输电塔的振动较单塔振动复杂,塔顶位移响应较单塔增加幅度较大,强风时塔-线体系的耦合振动现象较为明显,其振动响应表现出非线性系统特有的动力现象,振动过程中系统自振特性不断变化,风致振动激起了线性系统未有的振动频率。输电塔-线体系的结构设计需合理考虑输电塔与输电线的耦合振动对结构动力特性的影响。

关键词: 输电塔-线体系 单塔 气弹模型 风洞试验 非线性振动 风致破坏

Wind tunnel test on wind-induced response of transmission tower and tower line coupling system

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Abstract: In order to investigate wind induced dynamic responses of high-voltage transmission tower and tower-line coupling system, aeroelastic models were designed based on a typical 500kV transmission tower. The responses of the single tower model and the tower-line coupling system model were tested under the turbulent flow in a boundary layer wind tunnel. The results show that the magnitude of the along-wind response and that of the across-wind response in the turbulent flow is in the same order. The sensitivity of the responses of the tower-line coupling system model to the wind is higher than that of the single tower model. The displacement responses on the top of the tower in the coupling system are much larger than that of the single tower. The coupling vibration phenomena between the tower and the cables are very obvious under the strong wind. The natural oscillation characteristic of the tower-line coupling system changes constantly and the vibration frequencies different from the linear tower system are aroused, which reveals that the wind-induced vibration of transmission tower-line coupling system has strong nonlinear dynamic characteristics. It is concluded that the design process for tower and cables of transmission line system need consider the influence of the coupling vibration.

Keywords: single tower aeroelastic model wind tunnel test nonlinear oscillation wind-induced failure

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