

学术论文

大型双曲冷却塔气弹模型风洞试验和响应特性

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摘要: 双曲薄壳冷却塔是典型的风敏感结构,气动弹性模型风洞试验是研究其风振响应的有效方法。根据某大型双曲冷却塔结构动力特性和风振响应的特点,按相似准则合理简化,成功设计和制作了这一复杂结构的气动弹性模型,并在大型边界层风洞中模拟的B类风场、7个工况共112个风向角下进行了试验。根据试验结果可得:结构的位移响应特征参数均和风速呈现线性关系,干扰作用减小了位移响应的均值,增大了其脉动量,并使其沿环向的变化趋势发生改变;8m/s风速下测压试验计算的结构响应值相比气弹试验结果均值偏小、均方差偏大;单塔工况下背景分量占据主导地位,而多塔干扰影响使背景分量不再居于主导地位,共振响应趋于显著;多塔干扰下以原型结构10cm位移为阈值计入风振系数贡献的测点数减少,但是响应根方差增大,其风振系数均值相比单塔下结果明显变大。

关键词: 双曲冷却塔 气动弹性模型 等效梁格设计法 风洞试验 风致响应

Wind tunnel test on aeroelastic model of large hyperbolic cooling towers and features of wind-induced response

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Abstract: Hyperbolic cooling towers have become a kind of typical wind-sensitive structures due to their flexible and light features.An aeroelastic model of a cooling tower was successfully designed and manufactured on proper simplification of the similarity rules and based on the characteristics of the structure and wind induced vibration responses of such structures.The model was tested in a wind tunnel under 112 wind directions and the simulated wind field of terrain category B.The effects of wind direction and wind speed on the structural acceleration and displacement responses were discussed and the characteristics of power spectra of displacement responses of some typical measurement points were investigated.The test results indicated that the total responses of fluctuating standard deviation of surface measurement points are very regular,the value of wind vibration coefficient is less than the rule value,and the primary wind-induced displacements are appeared in the first half of cooling tower,especially in the throat.Interference effect makes the energy of displacement response power spectra increases,and the number of measured points participating the wind induced vibration coefficient induces.The results of average displacement obtained by the aero-elastic model test are more than the results calculated with data measured through rigid model pressure-measured test.

Keywords: aeroelastic model equivalent beam-net design wind tunnel test wind-induced response

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