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学术论文

湍流边界层中低矮建筑绕流大涡模拟

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摘要：

通过对平板湍流边界层进行大涡模拟，采用拟周期边界条件维持湍流边界层厚度稳定，提取速度和压力时程作为低矮建筑绕流模拟之脉动入流边界条件，研究脉动入流下的低矮建筑绕流特性。研究结果表明：入流边界特性对网格变化适应性良好，其平均速度剖面、湍流强度、流速频谱特性基本符合空旷地貌风场特性；脉动入流下，建筑表面的平均风压系数、脉动风压系数的计算结果与风洞试验结果基本吻合。受雷诺数及湍流强度的影响，流动分离区负压与试验值存在一定差别；屋盖上分离区风压时程具有非高斯概率特性，尤以气流分离较剧烈的屋盖迎风边缘及屋盖两侧风压的非高斯特性明显，该特征与风洞试验基本一致；受非高斯特性的影响，建议峰值因子g取4.5~5.5。

关键词： 低矮建筑 结构抗风 大涡模拟 脉动入口 风压系数

Large eddy simulation of flow around a low-rise building immersed in turbulent boundary layer.

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Abstract:

A turbulent boundary layer developed on the flat plate was simulated using large eddy simulation, and a quasi-periodic boundary condition was used to keep boundary layer thickness constant. Velocity and pressure history were extracted from the turbulent boundary layer and were set as the inflow condition for the flow simulation around a low-rise building, flow and pressure characteristics under turbulent inflow were studied. The results show that the properties of turbulent inflow can be well preserved in non-uniform grid system. Velocity profile, turbulent intensity and spectrum properties of the inflow are similar with those of wind field on open area. Mean and fluctuating pressure coefficients on building surface are basically in agreement with wind tunnel test, except for the flow separation regions, which could be attributed to discrepancy of the turbulent intensity and Reynolds number between present simulation and wind tunnel test. The pressure on the roof shows non-Gaussian property, especially in flow separation region, such as windward edge and side edge. The non-Gaussian properties are in good agreement with wind tunnel test. Due to the pressure non-Gaussian properties, higher peak factors are recommended when predict gust pressure on the roof, the value of g=4.5-5.5 are recommended.

Keywords: low-rise building wind resistant large eddy simulation turbulent inflow wind pressure coefficient.

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参考文献：

本刊中的类似文章

1．李秋胜;戴益民;李正农;.强台风“黑格比”作用下低矮房屋风压特性[J]. 建筑结构学报, 2010,31(04): 62-68

2．宋芳芳;欧进萍;.低矮建筑风致内压数值模拟与分析[J]. 建筑结构学报, 2010,31(04): 69-77

3．李寿英;陈政清;.泉州中芸洲海景花园建筑群体的干扰效应研究[J]. 建筑结构学报, 2008,29(02): 19-24

4．李宏男;伊廷华;.大连市贝壳博物馆表面风压分布特性风洞试验研究[J]. 建筑结构学报, 2007,28(S1): 90-97

5．李方慧;倪振华;沈世钊;.不同地貌下几个典型屋盖的风压特性[J]. 建筑结构学报, 2007,28(01): 119-124

6．李元齐,田村幸雄,沈祖炎.球面壳体表面风压分布特性风洞试验研究[J]. 建筑结构学报, 2005,26(05): 104-111

7．陆锋,楼文娟,孙炳楠浙江大学建筑工程学院.大跨度平屋面结构风洞试验研究[J]. 建筑结构学报, 2001,22(06): 87-94

8．吴太成,陈钦豪.深圳机场航站楼扩建工程风压风洞试验研究[J]. 建筑结构学报, 1997,18(04): 44-50

9．李寿科， 李寿英， 陈政清.开合屋盖体育场风荷载特性试验研究[J]. 建筑结构学报, 2010,31(10): 17-23
