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SIMULAÇÃO NUMÉRICA E EXPERIMENTAL DE ESCOAMENTOS TURBULENTOS EM TORNO DE OBSTÁCULOS

Por

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Resumo

Apresenta-se, enquadrado na área da Engenharia do Vento, um estudo numérico e experimental de escoamentos turbulentos de ar em torno de obstáculos, tendo em vista a caracterização do campo de velocidade para estudos de conforto de transeuntes.

A simulação numérica compreende a resolução das equações de conservação da quantidade de movimento e da continuidade, escritas na sua forma para regime permanente. A discretização das equações diferenciais é feita com base na formulação para volumes finitos. A ligação entre as equações de conservação de quantidade de movimento e massa é feita através do algoritmo SIMPLEC. São avaliados comparativamente o esquema híbrido e dois esquemas de discretização dos termos convectivos de ordem superior.

A simulação da turbulência é avaliada com base em cinco modelos de duas equações de transporte. O desempenho global do modelo computacional é determinado pela comparação dos seus resultados com os valores experimentais, em diversas configurações físicas estudadas. Para casos teste começa por se simular o caso de um cubo isolado assente sobre uma superfície, para dois ângulos de incidência, situação em que se comparam valores do coeficiente de pressão e velocidade em diversos perfis no rasto do corpo. Os outros casos teste consistem na modelação do escoamento em torno um cilindro paralelepipédico colocado transversalmente numa conduta, e de um obstáculo de secção quadrada, com diferentes relações altura/largura, assente na superfície inferior de um canal, comparando-se os valores previstos da componente longitudinal da velocidade, e também da vertical num dos casos, com os experimentais. Testa-se igualmente um conjunto de edificações, sendo os resultados obtidos comparados com os da modelação numérica e experimental de outros

autores. Constata-se que o modelo k-ε RNG apresenta resultados que mostram uma melhor concordância com os valores experimentais, sobretudo para situações com zonas de recirculação.

Na subsequente parte da tese faz-se uma aplicação do conhecimento já obtido ao estudo de uma situação real, através da avaliação e análise dos ventos previstos na Área Internacional Sul, que faz parte do recinto da EXPO '98, estudo que envolve ambas as componentes computacional e experimental.

A componente experimental deste trabalho consiste na medição de perfis verticais e horizontais da velocidade média do escoamento, para dois ângulos de incidência, empregando uma sonda de filme quente e uma sonda de sete orifícios, num modelo à escala 1:175 da Área Internacional Sul, ensaiado num túnel aerodinâmico.

Adoptando o modelo k-ε RNG para simulação da turbulência, o desempenho do modelo computacional desenvolvido é testado para uma situação real através da simulação da Área Internacional Sul, comparando os valores numéricos com os medidos experimentalmente. São simuladas condições de presença e ausência de duas estruturas auxiliares com vista à análise da sua influência na distribuição da velocidade nos diversos corredores entre os vários pavilhões.

Na situação da presença das estruturas auxiliares, é feito um estudo sistemático para diversos rumos de incidência, simulando o quadrante que se julga ser mais susceptível de criar condições de desconforto. A comparação dos resultados numéricos com os da simulação experimental mostra que o modelo computacional é capaz de prever de forma correcta as principais características do escoamento mesmo para esta geometria complexa, sendo identificados vários pontos críticos em termos de conforto pedestre.

Os resultados de ambos as simulações são comparadas com os dados medidos na Área Internacional Sul através de um grupo de estações meteorológicas instaladas. A análise dos dados adquiridos na situação real mostra que a simulação numérica prevê os principais aspectos do escoamento.

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