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THE INVESTIGATION OF THE ROTATIONALLY OSCILLATING PLATE'S FLOW FIELD AND ITS THREE-DIMENSIONAL NUMERICAL SIMULATION

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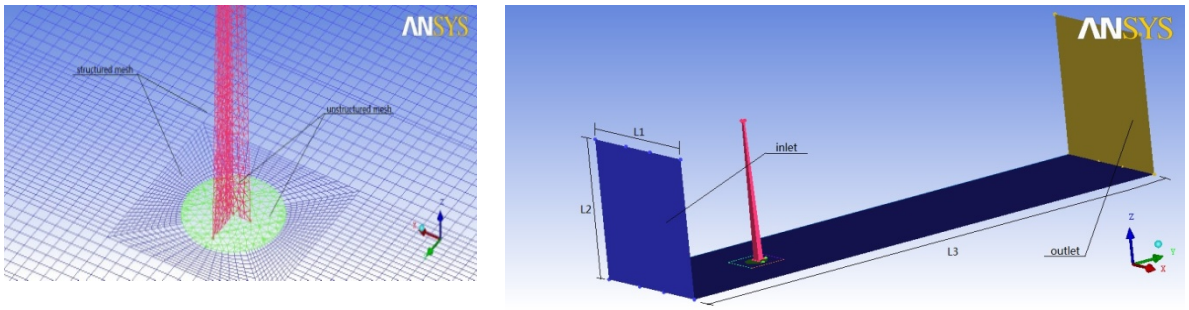
INTRODUCTION

The simulation of bluff body with moving boundary and to control the wake flow of bluff body is an important issue in computational wind engineering. In recent years there are few researches concerning the flow around the rotationally oscillating plate, neither is the problem of the combination plate flow. In order to get some qualitative rules, combined with wind tunnel test, CFD numerical simulation is applied to investigate the characteristic of flow around a three-dimensional rotationally oscillating plates in this paper. The main work is to simulate the flow field with the plates which confronts the incoming flow and the plate which is positioned to separate the incoming flow rotating under different rotating angles and with different frequencies. The simulation data is compared with experiment results to verify the valid of the simulation techniques.

NUMERICAL SIMULATION



(a) The hybrid grids used in CFD (b) CFD simulation zones

Fig.1 CFD simulation （L1=500mm,L2=500mm,L3=1980mm）

The numerical model was obtained by embedding the motion code of the rotationally oscillating plate through the User Defined Function (UDF) in Fluent. To investigate the aerodynamic characteristics of the rotationally oscillating plate and the characteristics of wake flow, several numerical schemes have been tested with different amplitudes and frequencies. As the wind tunnel experiments will be carried out with the same size model and motions, from the point of convenient comparison, the calculation field will be set up with the same size of wind tunnel, that is L1=500mm,L2=500mm,L3=1980mm as shown in Fig.1. The

boundary condition will be set as wall corresponding to the wind tunnel walls. The Semi-Implicit Method is used for the numerical simulation with Pressure-Linked Equations(SIMPLE).The basic idea of SIMPLE is to solve the velocity field according to the pressure field. The Reynolds stress equation model (RSM) is applied as the turbulence model and the transient calculation is carried out with time step of 0.005 seconds. Hybrid grid is divided in the meshes : a cylinder volume near the oscillating plate is divided with nonstructured meshes, others with structured meshes(shown in Fig.1).

CONCLUSIONS

1. The turbulence intensity of the wake zone increases when the amplitude reduces while the plate ocilate fast; 2.Two parallel combined plates can effectively increase the turbulence intensity of the wake; 3 With the distance ratio between two parallel combined plates changed, two different wake patterns occur.

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