CHAPTER I

INTRODUCTION

1.1 MOTIVATION OF RESEARCH

In air-handling systems , devices that are used to ensure proper operation of the various air system are called *dampers*.

Dampers consist of one or more vanes , doors , or blades hinged orpivoted , so that they can be rotated to various positions for controlling the flow of air into a furnace or through an air-conditioning duct (see figure 1.1).

Dampers may be adjusted by hand or automatically positioned by damper motors. Regulation of air flow in heating , ventilating and air-conditioning systems is accomplished by automatic control dampers (see figure 1.2).

Control dampers are designed to control the flow of air in a ductwork system in much the same way as an automatic valve does in a fluids circuit , that is by varying the resistance to flow. When selecting automatic control dampers consideration should be given to type , size , flow characteristics , rangeability , required pressure drop and so on , and to the provision of suitable damper operator having the required timing , stroke and torque ratings. (Croome and Roberts , 1981)

The single blade damper is generally restricted to small sizes since it does not provide accurate control. When fitted in circular ductwork it is referred to as a butterfly damper. A multi-blade or louvre damper has two or more blades linked together. Two basic styles of multi-blade damper construction are (see figure 1.3)

- The *parallel blade damper* : it has its blades linked so that when operated they all rotate in the same direction.

- The *opposed blade damper* : it has adjacent blades linked to rotate in opposite directions when operated.

When any type of damper is present in the duct , there is an effect on the measuring of the flow rate in downstream direction , is so called *installation effect*. If a flow meter is located within a range of this effect , accuracy of the flow measurement will be reduced.

Presently , more than 50 % of flow meters installed in the oil and gas industry are of the differential pressure (DP) type. This group of flow meters would include orifice meter , venturi meter and point measurements velocity devices , such as the Pitot-static tube. The popularity of these flow meters can be attributed primarily to their simplicity , robustness and low maintenance requirements. However, their main disadvantage is their sensitivity to the installation effect. According to Aichouni , Laws and Ouazzane (1996) ; flow meters are affected to some extent by the quality of the flow approaching the meter. In case of differential pressure flow meter , it is known to be affected particularly by mean flow distortions (profile symmetry) , swirl , turbulent fluctuations and pulsations in the approaching flow. However , these terms are more certain when the flow has fully developed.

To avoid the installation effect , the meter should be installed in the fully developed flow region. Nevertheless , the region varies with upstream flow conditions (downstream flow of the damper) mostly depending on flow rate , configuration of the damper and duct , and air properties such as viscosity.

In the present study , velocity distribution of air flow passing an obstacle (damper) in a square horizontal duct is simulated. Asymmetric distorted velocity profiles are created by the flow past the axisymmetric body i.e., a single flat plate or multiple linked flat plate , with various degree angles of attack. These simulations lead to specify the range that no influence of installation effect which is the region of fully developed flow.

1.2 OBJECTIVES OF THE STUDY

There are two main objectives which are described as below.

The first is to study on the phenomena of fluid when flow past the parallel inclined flat plates in a square duct in order to determine the regions of fully developed flow in various conditions.

The second is to apply the technique of computational fluid dynamics (CFD) for the present study.

1.3 SCOPE OF THE STUDY

This study is undertaken to predict the phenomena of turbulent flows past the parallel inclined flat plates with various numbers and inclinations of the flat plates in a square horizontal duct by using computational fluid dynamics (CFD) technique.The computer program *PHOENICS* is adopted to simulate for three-dimensional flow and verified the results with experimental data to confirm the accuracy of predictions. For further application of the present modeling is to examine the effect of high Reynolds number that deals with the dimension of the duct , and also the inlet velocity of the air flow , to correspond with the real practice case.

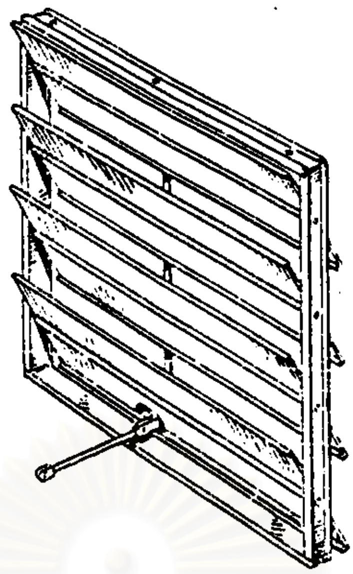

Figure 1.1 Damper.

Figure 1.2 Opposed blade automatic control damper.
(courtesy Honeywell Ltd.)

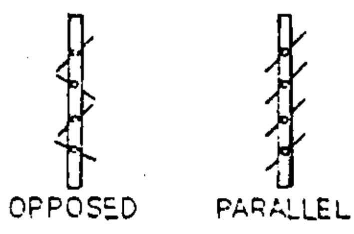

Figure 1.3 Damper blade arrangement.