A Review on Air Conditioning Effectiveness and Supply Air Conditions

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Abstract: ***Air conditioning is essential for the indoor environment to be kept controlled at the desired conditions. The importance of controlled conditions has been found in literature in enhancement of human work productivity and machine or equipment performance. Huge energy is being used by the air conditioning systems. The researchers are doing research on various areas of air conditioning including refrigerants, air distribution systems, thermal comfort conditions. Many researches have also been found in literature review on the research methodology involving experimental, mathematical and numerical studies. It is found that the numerical methods and tools available are very much powerful and providing results in acceptable accuracy limits. These tools save time of experiment and cost. Computational Fluid Dynamics (CFD) using Fluent in Air conditioning studies and indoor environment analysis has been widely used by the researchers as found in the literature review. The results obtained from CFD analysis were also compared from the experimental findings and the variations are not significant providing acceptable results.***

Key Words: Air conditioning, CFD, Indoor environment, Temperature distribution, Velocity distribution.

I. INTRODUCTION

Air conditioning provides the indoor thermal environment in a controlled state. The thermal controlled conditions of indoor environment provide thermal comfort which is a combination of a human sensation and interactions with the environment. Human comfort depends upon several parameters including physical magnitudes, body temperature, Metabolic dissipation rate, clothing, activity levels etc. All these factors vary in a space throughout the year in various combinations naturally. Most people need a comfortable physical environment for their better living and in performing their activities as they spend a great part of their lifetime staying indoors. Thermal environment is the most important factor of the human comfort. Human comfort is obtained when the temperature with other physical parameters are controlled in the environment. Thermal comfort is defined as the condition of mind which expresses satisfaction with thermal environment [1]. Refrigeration and Air conditioning is the field of engineering involved in providing techniques of controlling indoor thermal parameters and ways to achieve human comfort. The engineers are always interested in design the air conditioning system which satisfy the requirements of indoor environment and effectively control of the physical environment parameters.

II. AIR DISTRIBUTION

The occupied zone in the conditioned space is defined as the space in the conditioned zone that is from the floor to a height of 1.8 m and about 30 cms from the walls. For the comfortable thermal indoor environment a proper combination of temperature, humidity and velocity or air motion is needed in the occupied zone. The maximum variation in temperature in the occupied zone should be less than $1^{o}C$ and the air velocity should be in the range of 0.15 m/s to 0.36 m/s.

III. ANALYSIS IN AIR DISTRIBUTION

The need of analysis of air distribution system to provide comfortable indoor environment is very much needed for the information of indoor environment and comparison of effectiveness and performance in providing comfort of one system over other. Indoor air movement and temperatures have very close relation with the thermal comfort [2] in the conditioned zone. However, air movement within a room depends upon several factors [3]. Indoor air movement is often induced by the supplied air by forced convection [4]. It is also caused due to the natural convention or the temperature difference between the supply air and the walls of the conditioned space. Pressure difference also causes air movement and it may be considerable.

IV. COMPUTATIONAL FLUID DYNAMICS

With the increase in computational power Computational Fluid Dynamics (CFD) is gaining significant popularity in research and analysis of engineering problems involving fluid flow. Numerical simulation using CFD is often considered more illuminating and effective in cost savings as compared to the laboratory or field experiments.

Computational Fluid Dynamics (CFD) is the approach to solve the fluid flow problems using mathematical physical problem formulation and use of numerical methods involving discretization methods, solvers, numerical parameters, and grid generations, etc.. The process of CFD solution of problem may be shown as in figure 1.

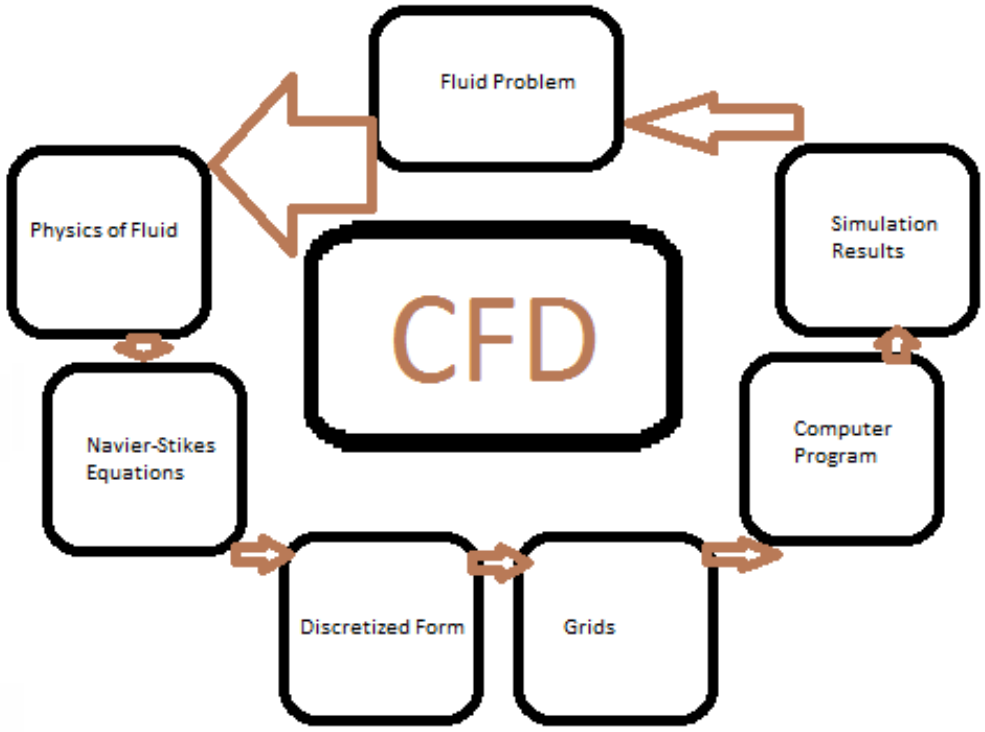

Figure 1: Problem solving by Computational Fluid Dynamics.

For problem solving on CFD, we need to know the properties of fluid involved in the problem. Governing equations of the problem in mathematical form are used with the physical proberties to formulate the problem. These equations are called the Navier-Stokes equations. For solving these equations we need a computing machine to reduce time and numerical discretization methods such as finite difference, finite element, finite volume methods to numerically translate Navier-Stokes equations into discretized form for solving on computer.

In CFD solution of problems, the whole domain is splitted into large number of small parts as the discretization is based on it. These equations are then solved with the help of program written on computer programming languages such as Fortran or C. On solving these equations the simulation results which can be compared with the experimental results for validation are obtained.

V. CONCLUSION

Air conditioning is essential for the indoor environment to be kept controlled at the desired conditions. The importance of controlled conditions has been found in literature in enhancement of human work productivity and machine or equipment performance. Huge energy is being used by the air conditioning systems. The need of analysis of air distribution system to provide comfortable indoor environment is very much needed for the information of indoor environment and comparison of effectiveness and performance in providing comfort of one system over other. Computational Fluid Dynamics (CFD) using Fluent in Air conditioning studies and indoor environment analysis has been widely used by the researchers as found in the literature review. The results obtained from CFD analysis were also compared from the experimental findings and the variations are not significant providing acceptable results.

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