International Journal of Engineering & Technology, 7 (3.7) (2018) 482-485

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Modified Turning Vanes in Air Distribution System of HVAC for Thermodynamics Lab

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Abstract

The objective of our study is to develop a new design of turning vanes. We have developed two types of turning vanes, proposed turning vanes 1 and 2 which will then virtually install on thermodynamics laboratory. The result of the simulation was then compared with the conventional turning vanes 1 and 2. It was found that the proposed turning vanes 2 gave better results compared to the conventional turning vanes 2 with improvements of 43.5% in velocity distribution and 16.0% in pressure distribution respectively. The results showed that the best turning vanes was conventional turning vanes. As a conclusion, conventional turning vanes produce better result compared to proposed turning vanes when it virtually applied to the thermodynamics lab. It can be implied that conventional turning vanes produced better outlet velocity compared to the proposed turning vanes. Real experiment should be conducted to verify the numerical result.

Keywords: *Airflow; Duct; HVAC; Simulation, Vanes*

1. Introduction

Air distribution system consists of three major components which are air handling unit (AHU), ductwork system and components of heating, ventilation and air conditioning. Heating, ventilation and air conditioning (HVAC) system is a system used to heat or cool as well as ventilate residential, commercial or industrial buildings. In general, air distribution system is responsible to provide fresh outdoor air to dilute interior airborne contaminants such as odours from environments, volatile organic compounds (VOC's) which are emitted from interior furnishings and chemicals used for cleaning. Since air distribution system consists of many components and will consume large amount of energy, the components need to be installed with proper monitoring and maintenance. Proper installation and maintenance will lead to the efficient energy utilization [1]. The study of the ventilation system can be done either numerical or experimental [2]. The study in terms of numerical can be done by visualization of the flow where it is done using computational fluid dynamics software [3].

Turning vanes is not a new concept in HVAC industry as it reduced the pressure loss in ductwork of HVAC system. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has set up guidelines about usage of turning vanes in the elbow of the bends. The function of turning vanes is to reduce the sudden impact of airflow to the wall of the duct [4]. Thus, making the airflow to be smoother when changing direction of the airflow. Furthermore, turning vanes not only used in HVAC industry but also in gas-turbine design where the called it as guide vanes which deliver similar purpose as turning vanes. Material of the guide vanes play important roles in term of its performance. The material of guide vanes also can cause more energy saving based the research of Junaidi [5]. Different angle of the inlet turning vanes would give different outlet result according to Cheng [6]. According to McFarlane [7], the installation of turning vanes is compulsory to the turning vanes when the air velocity is greater than 1000ft/m. However, the industry has misunderstood the installation of turning vanes on the return ducts and exhaust duct is not compulsory whereas the contractor understood the importance of turning vanes installation on the supply duct. Factors that affect the performance of the system when installation of turning vanes was done is the number of bends, the number or degrees in each bend and the amount of sag allowed between the supports joists [8]. Undersized and constricted ductwork are thought to be key culprits that lead to excess external static pressures in many systems [9]. To overcome the losses that occur on the duct, flexible duct can be used within the underfloor plenum so that it could deliver cool air [10]. Material of the ductwork play importance roles towards the air flow. The use of suitable material can cause the system to be more energy savings [11]. The objective of our research is to develop a new design of turning vanes, which would reduce the losses on the ductwork of thermodynamics lab of UNIMAS.

This paper conducted research to develop a new design of turning vanes. It will then enhance the flow in the ducting which will reduced the losses occur at the bend of the duct.

2. Materials and Methods

This study was conducted by using Computer Aided Design (CAD) software which is AutoCad in designing the turning vanes and the thermodynamics laboratory of UNIMAS. The use of Computational Fluid Dynamic (CFD) software which is Ansys as a method in simulating the air flow in the ductwork. The simulation was conducted on the 90◦ bend first before it is virtually applied towards the ductwork of thermodynamics laboratory.