UNIVERSITI TEKNIKAL MALAYSIA MELAKA

An Investigation on variable system with automatic damper and controllable motor blower speed using a trainer kit

This report submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree of Engineering Technology (Bachelor of Mechanical Engineering Technology in Refrigeration and Air-Conditioning Systems) with Honours

By

MOHD ALAIRIZZAMAN BIN HAMDAN

B071410720

920804065435

FACULTY OF ENGINEERING TECHNOLOGY

2017

DECLARATION

I hearby , declared this report entitled "Evaluation Of Decentralised Fans Effectiveness In Office Building Ventilation System" is the results of my own research except as cited in references.

Signature :

.....

Auther's Name : MOHD ALAIRIZZAMAN BIN HAMDAN

Date :

.....

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Refrigeration and Air-Conditioning Systems) with Honours. The member of the supervisory is as follow :

.....

(Madam Noor Saffreena Binti Hamdan)

TABLE OF CONTENT

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

AHU	-	Air Handling Unit
CFM	-	Cubic Feet per Minute
HVAC	-	Heating, Ventilation and Air-Conditioninglb
mm	-	Milimeter
m^3/h	-	Meter cube per hour
m/s	-	Meter per second
In	-	inches
RPM	-	Revolution per minute

ABSTRAK

Sistem HVAC digunakan dalam kehidupan seharian dan bangunan industri untuk memenuhi keperluan keselesaan haba dan kualiti udara dalaman. Dalam Pemanasan, Pengudaraan dan pendingin udara (HVAC) sytem, Terdapat dua kategori sistem penghawa dingin seperti air disejukkan penyejuk dan udara yang disejukkan penyejuk digunakan untuk bangunan. Pelbagai sistem boleh mengekalkan keselesaan yang lebih besar di seluruh bangunan sambil menjimatkan tenaga dengan membenarkan zon yang berbeza daripada bangunan berada pada suhu yang berbeza. Penjimatan besar datang apabila satu unit yang disediakan untuk zon tidak diduduki dapat dimatikan. Walau bagaimanapun kini menambah zon dan memikirkan berapa kerap zon yang sedang digunakan dan berapa banyak tenaga boleh disimpan dengan mematikan pemanasan dan penyejukan ke zon yang tidak digunakan. Tanpa pelaksanaan peredam automatik dalam sistem HVAC, udara akan terus dibekalkan kepada bilik yang tidak digunakan atau bilik kosong. Jadi, apabila ini berlaku, pembaziran tenaga akan berlaku. Kit jurulatih telah dibangunkan untuk menyiasat masalah ini. Pembaziran tenaga boleh dikurangkan dengan menggunakan peredam automatik. Untuk mencapai tahap kecekapan tenaga yang lebih baik, kipas blower motor mesti dikawal memastikan kadar aliran udara untuk setiap bilik telah penghuni tidak terjejas apabila peredam ditutup di dalam bilik yang tidak digunakan. Oleh itu kajian ini akan memberi tumpuan kepada kecekapan tenaga apabila menggunakan peredam automatik dan dikawal kipas blower motor. Membina 6 bilik dan untuk saiz setiap bilik 12in x 9in. Perspek adalah bahan yang akan digunakan untuk membina kit jurulatih. Selain itu, aluminium lembaran logam juga menggunakan untuk kit jurulatih ini. Peralatan yang digunakan untuk membina kit jurulatih sedang Lenturan Mesin, Gunting memotong kepingan aluminium, perspek memotong pisau. Data peroleh akan nalyzed dengan kaedah secara teori.

ABSTRACT

HVAC systems used in living and industrial buildings should fulfil thermal comfort needs and indoor air quality. In Heating, Ventilation And Air conditioning (HVAC) sytem, there are two catogeries air conditioning system such as water cooled chiller and air cooled chiller used for building. Multiple systems can maintain greater comfort throughout the building while saving energy by allowing different zones of the buildings to be at different temperatures. The greatest savings come when a unit serving an unoccupied zone can be turned off. However now add zoning and think of how often that zone is being used and how much energy can be saved by turning off the heating and cooling to those zone when they are not being used. Without implementation of automatic damper in a HVAC system, the air will remain supplied to an unused room or an empty room. So, when this happen energy will be wastage. A trainer kit has been developed to investigate the problem. This energy waste can be reduced by using automatic damper. To achieve a better energy efficiency level, the motor blower fan must be controlled to make sure air flow rate for each room has occupant not affected when the damper is closed in unused rooms. Thus this study will focuses on the energy efficiency when using the automatic damper and controllable motor blower fan. Build 6 room and for size each room is 12in x 9in. Perspex is the material that will be used for build a trainer kit. Besides that, aluminium sheet metal also using for this trainer kit. The equipment used for build a trainer kit are Bending machine, Scissors Cutting aluminum sheets,perspex cutting blades. The data obtain will be nalyzed with the theoretically method.

DEDICATION

I dedicate this dedication to my creator God Almighty. for having given me a lot of patience and perseverance in completing this project. I also want to dedicate this dedication to both my parents gave me that much inspiration and many lifted my spirits when I almost gave in to complete this project. not forgetting to supervisors who have helped me and led me from the beginning to the end of this project

ACKNOWLEDGEMENT

first of all I would like to say thousands of thanks to my supervisor madam noo saffreena daughter hamdan because oversaw and led me with sincerity and a lot of help and the process of completing this project. I have managed to gain knowledge and experience during the making of this project. In addition, thanks to the infinite also spoken to both my parents for never-ending prayer and give words of encouragement to me until I managed to finish this project. lastly not forgetting also to all the friends who helped. I feel very grateful for the help and provides a lot of support in ensuring that the project is successful

CHAPTER 1
INTRODUCTION

1.1 Introduction

The title of this project is "An Investigation On Variable system with automatic damper and controllable motor blower speed using a trainer kit". This chapter intend to discuss and introduce the background of the title, the problem statement and research objective.

1.2 Background

HVAC systems used in residential and industrial buildings intends and should fulfil thermal comforts requirement and indoor air quality of the intended space.(Soyguder & Alli, 2009). In Heating, Ventilation And Air conditioning (HVAC) sytem, there are two catogeries of air conditioning system, which are water cooled chiller and air cooled chiller used for building. And as known, ducting is a main component to flow the air from the system into the every room in building.

In the ducting sytem, there is another one of component that has been used, which is a damper. There are two types of damper, a manual damper and an automatic damper. Manual damper is control by human interaction such as touch while automatic damper is control using a sensor or other electrical control. Damper main objective is to adjust the percentage of air flow through the diffuser, thus controlling the air supplied to the rooms.

Nowadays, buildings that uses HVAC systems required and comprised a large portion of energy.(Wemhoff & Frank, 2010). Buildings often use two or more separate heating and air conditioning units for different floors or areas. Multiple systems can maintain greater comfort throughout the building while saving energy by allowing different zones of the buildings to be at different temperatures. The greatest savings come when a unit serving an unoccupied zone can be turned off.

Rather than install two separate systems, HVAC contractors can provide automatic zoning systems that operate with one system. The ductwork in these systems typically has a series of thermostatically controlled dampers that regulate the flow of air to each zone. Although somewhat new in residential construction, thermostats, dampers, and controls for zoning large central systems have been used for years in commercial buildings.(Conditioning, 2015)

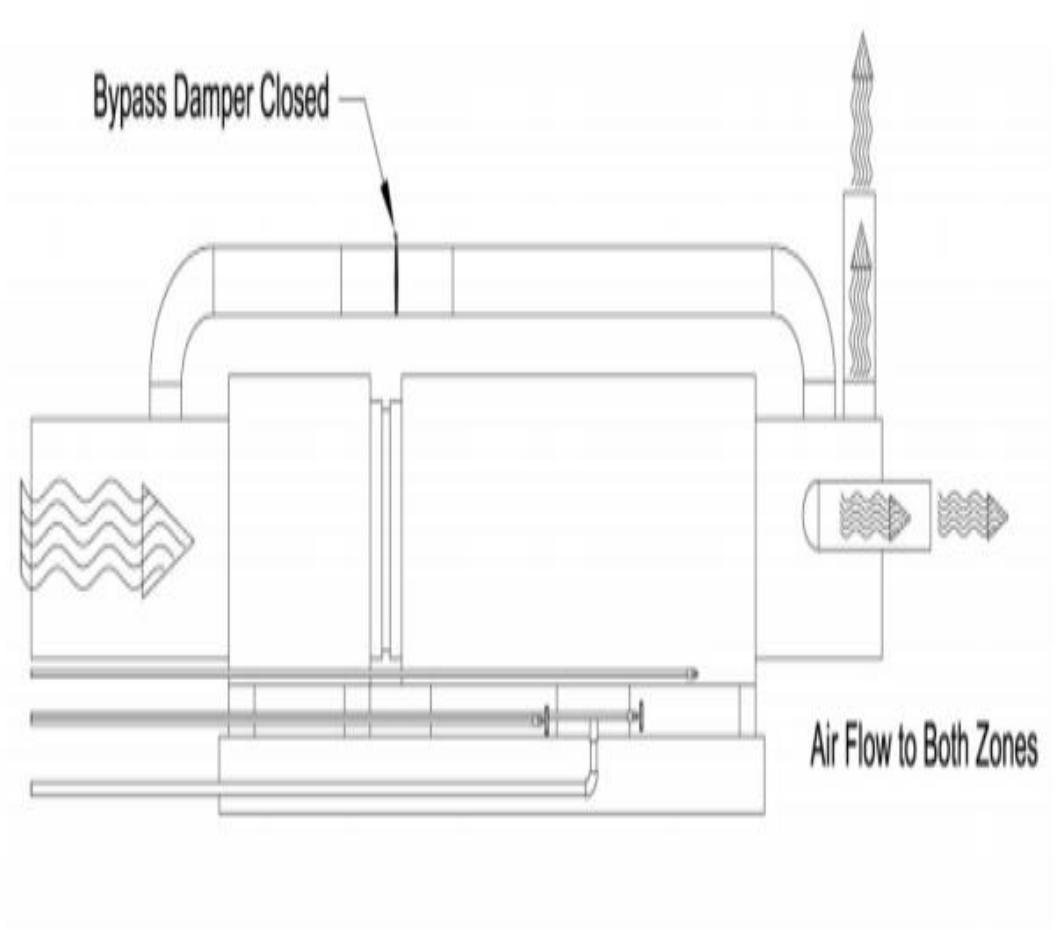

Figure 1.1 Automatic zone system

In large buildings, the HVAC system must meet the varying needs of different spaces. Different zones of a building have different heating and cooling needs. A zoning system delivers increased energy efficiency on any HVAC System. Zoning allows you to set back thermostats in zones not being used and prevents zones from be over heated or cooled while other zones are not yet comfortable.

Look at the illustration below showing one thermostat and a typical multi-level home. Each zone has an equal share of the energy bill. However now add zoning and think of how often that zone is being used and how much energy can be saved by turning off the heating and cooling to those zone when they are not being used(“HVAC Zoning System s Table of Contents,” n.d.).

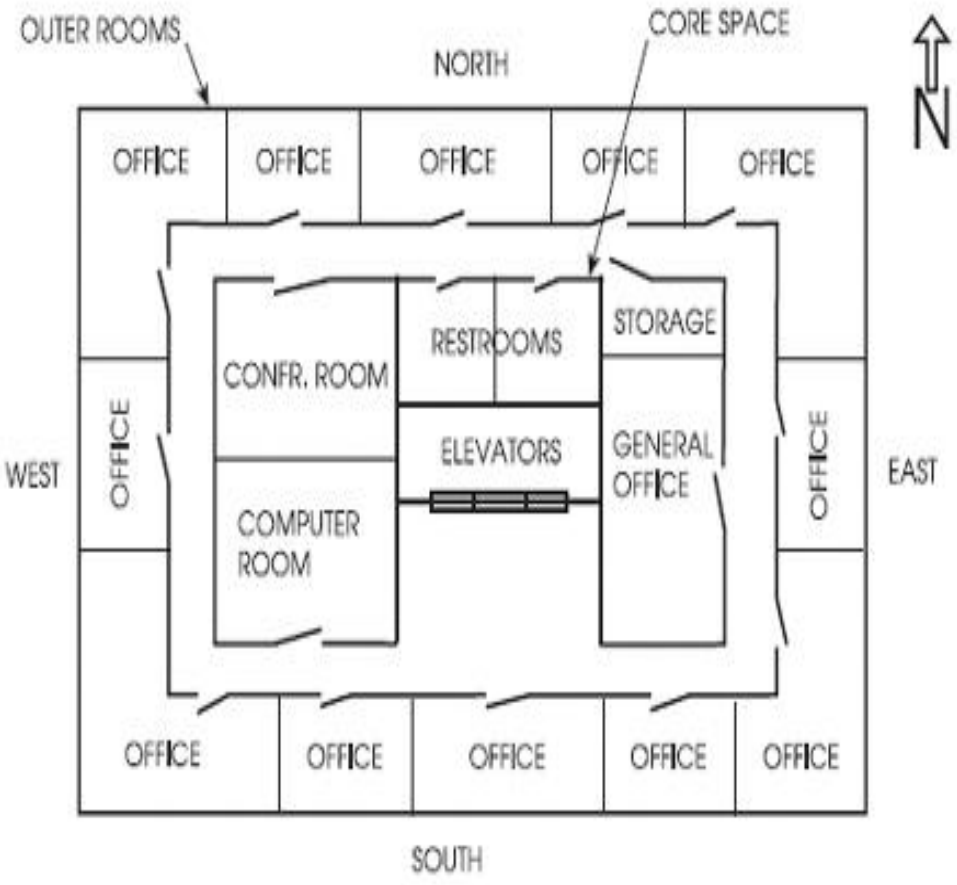

FIgure 1.2 Zones of the typical office building

1.3 The Purpose Of Research

The purpose of this project is to investigate the effect to power conumption in HVAC system when using automatic damper at empty and unused rooms, together with controllable motor blower fan. This project to be carried out to study the effects of the use of automatic damper and fan blower motor to power consumption.

By the end of this report, a functioning trainer kit should be created for acquiring data for this project. The testing and experimental work will be done to assure the trainer kit function.

1.4 Problem Statement

Without implementation of automatic damper in a HVAC system, the air will remain supplied to an unused room or an empty room. Due to this, energy wastage will occur because the air will stay supply in to a room without occupant. This energy waste can be reduced by using automatic damper. This is because the air flow will not supply into an empty room when a damper is closed.

To achieve a better energy efficiency level, the motor blower fan must be controlled to make sure air flow rate for each room has occupant not affected when the damper is closed in unused rooms.

1.5 Objectives

Based on the research tittle “An Investigation On variable FCU system with controlllable automatic damper and motor blower speed using a trainer kit” the objectives of this project are as followed :

a) To develop a trainer kit using automatic damper and controllable motor blower fan control by arduino program.

b) To analyze effect of using controllable motor blower fan to control air flow rate each room

1.6 Scope Of The Research

The investigation focuses on the power consumption when using the automatic damper and controllable motor blower fan. In order to achieve the project objectives, a trainer kit are build. For a trainer kit, will build 4 room . Perspex is the material that will be used for build a trainer kit. The important parameter involve are power consumption and air flow supply into a room when damper at unused room is closed. Parameter use to determine energy efficiency of the system is a air flow rate and motor blower speed.

2 CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter will focus on the theory and terms mainly related to this research, This source of theory is from previous research and related articles. The aim of this chapter is to give better understanding about this research and give strong evidence, support, and the reasons why this research should be done

2.1 Heating, Ventilation and Air Conditioning (HVAC) system

In Heating, Ventillation, and air conditioning system, there are one system specializes in distributing air which is called Air-Distribution Systems. An Air-Distribution Systems include many more small parts such as dutcworks , air handling units and any components associated . to maintain adequate indoor air quality at the same time, to provide air-conditioned air to the heating chamber or the coolant load in question. the air distribution system will be used. to maintain the desired conditions and suitable for temperature, humidity, airflow and so on, the system should operate uniformly because of separation of air distribution systems from many components. However, the use of smart plans for operational strategy and good maintenance practices can significantly reduce energy usage if the air distribution system uses a large amount of energy

to provide services to oversee the certification process, there were two major organizations being appointed, namely

- ACMA- they are one of the best air distribution systems organization and have been recognized as the standard for all products related to air movement such as silencers and fans.
- “national associaton of metal contractors and air condtioning, SMACNA - standard for fans, channel construction, plenum and installation have been recognized their publications in the air distribution system.

The terminal unit is the device used to control the temperature or total air supply to the intended space as specified in the operation and maintenance of the terminal unit. this unit is located near the space provided.

Constant volume, CV and Variable air volume, VAV are two categories divided into air distribution systems.

Only the temperature will be different to maintain the point of the temperature setting of the intended temperature. this is what is meant by a constant-volume system that only operates at constant airflow rate. a constant volume unit can be used for single zone or multizone applications.

Ventilation and cooling into conditioned rooms are provided in a single duct system. heating components in a terminal unit may be required for zones that may require temporary heating while the building system may depend on a completely unmounted system for installation

In addition to single ducts, another system is a dual duct system. this system transfers air through cooling coils and heating in air operators, AHU and distributes air through separate hot and cold channels and this system only uses a single fan. airflow can absorb each other on the terminal mix box or give cooling only depending on zone requirements

Multizone units are also one of the fixed volume systems of a central air handling unit, AHU air will be supplied to several zones for this unit. the thermostat will handle cold and hot air mixed by the damper according to individual zone requirements

And as for Variable-Air Volume, to maintain zone temperature setpoints, the volumes of supplied air from a VAV air handler varies as it responding from zones temperature. controlled air supply fan has been used to maintain pressure set points There are three methods to regulate the supply-air volume corresponding to a static pressure in the ducting:

- Bypassing Dampers
- Inlet Vanes (either upstreamfrom or inside the supply fan cassing)
- Variable-Speed Drive (VSD) on the fan motor regulating the fans speed.

The air will be heated in the terminal unit to provide heated air when necessary in a variable water volume system. this system will usually only provide ventilation for cooling.

Underground floor distribution system is a system that has been varied for VAV system design. the air operator will receive the movement of the low pressure air supply or sometimes the air will also bubble through the air supply shaft depending on the design of the system bench and become the airplane under the floor. if the heating is required, the supply air will travel immediately even if the separator is supplied to the conditioned room or to the terminal unit which may be additional heat from the heating coil to the air before entering the conditioned room. if the overall air volume in a conditioned room such as the VAV system overhead is not mixed with the supply air entering the floor conditioned floor, heating and cooling energy can be reduced

For the performance of the hvac system, the air return strategy should be well designed. the air distribution system will consider the back of the system as well as the side of supply. comfort problems may arise when overpressurization occurs where rooms with no sufficient air returns prevent the supply air flow. air routes should be present in each room with supply channels (excluding bathrooms or potable kitchens to disperse the smell through the house). (Burdick, 2011)

2.2 Component

In air distribution system, there are some components. The key components of air distribution systems are:

- Damper
- Fan

2.2.1 Damper

Valves or plates that stop or control airflow in the duct, chimney, VAV box, air operator, or other air handling equipment are known as dampers. the damper can be used to control the temperature in a room and the damper can also be used to cut off the central air conditioning (heating and cooling) to the unused room. Dampers are direct and controls the airflow through the air distribution systems. And for safety caused, such as preventation of migration of fire and smokes, the system. In terms of safety, the silencer can also be installed on a certain fire-proof or wall-mounted floor. A fire-alarm systems typically will be controlling these motorized units. But recent advances in study and technology, the HVAC DDC system is allowed to control the life-saving system as a result of the reliability of the digital direct control system (DDC)

To control the flow rate of the building, a commercial control controller system will be used. they can be used in air intake, eksoz or mixed air applications. (Vcd, 2013)

There are two types of damper operation. one operates manually and one operates automatically. the holder outside the channel works to open and close the manual damper. while the electric and pneumatic motor (air pressure) will automatically override the automatic damper to keep air. This automated system is controlled by thermostats. to control the rate of fire in the fuel combustion equipment may also charge the damper

2.2.1.1 Manual Damper

To control the amount of hot or cold air flowing to a particular room or area inside the building, can use manual-controlled dampers (by hand). dampers are not intended to be used in applications as positive closures or automatic controls even though the manual reducer balancing offsets is a control damper that regulates airflow. This silencer can only be controlled using the strength of the hand. There are three types of damper models

- MBD-10/10M is a single blade
- MBD-15 is a multi-blade
- MBDR-50 is a round blade

Remote balancing dampers offer the same function as a manual balancing damper. Equal functions such as manual balancing reducer, the only advantage of offset balancing this far is that it can control the damper from a distance on the diffuser or wall plate. if the application is difficult to gain access to adjust the damper manually to compensate for airflow, it is best to use this system. Damper motor controlled by "EZ balance" by connecting to wall, ceiling or diffuser mounted on RJ11. There are two types of this damper model:

- RBD-10 (single blade)
- RBDR-50 (round blade)

Figure 2.1 **T**ypes of manual damper

In general, if the zone airflow operator is in the trench, it will close the airflow because the lever holder controls the airflow duct or damper is parallel to the damper itself.

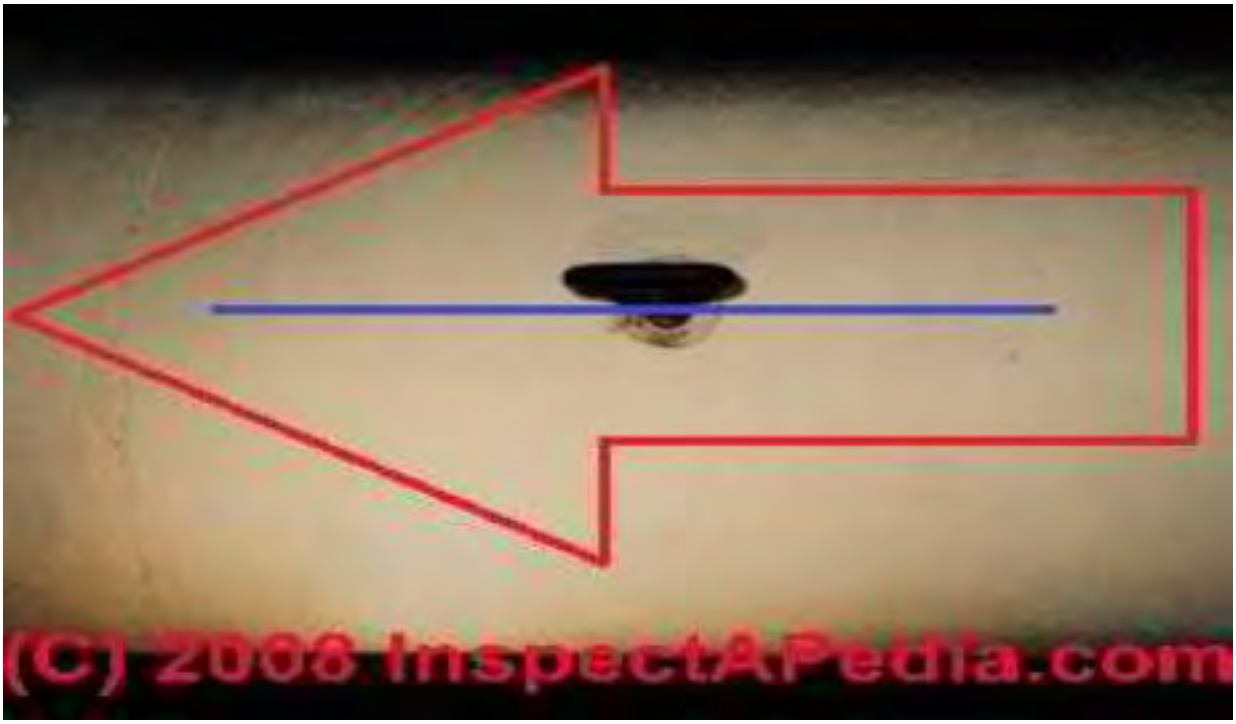

Figure 2.2 Position Of The Duct Damper

That is the position of the duct damper handle also indicates the position of the actual damping baffle inside the ductwork. The damper will be wide open when the damper is controlled parallel to the direction of the ductwork damper. but if the airflow does not seem to work as expected, some inspections can be done. maybe this is because the soaking is operated incorrectly.

Figure 2.2 shows the duct damper handle turned parallel to the direction in which this old (asbestos-paper covered) heating duct runs, so this airflow damper is in the "open" position.

2.2.1.2 Automatic Damper

A mechanical doors that are opened or closed under thermostatic control to provide indvidu area or heating or control of cooling zone in buildings conveyed by single warm air heater or central air conditioner known as automatic damper.