

HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

**DESIGN AND CONSTRUCTION OF AN
EXPERIMENTAL UNIT FOR BALANCING OF
DUCTED AIR SYSTEMS**

M/987

BY: NICOLAS A. KOUNTOURIS

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By: Nicolas A. Kountouris

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Summary

The purpose of this project is to present the theory around air flow in ducted air systems, and also to elucidate how this theory has been applied for the design of an experimental air ducting unit for air pressure balancing.

A balancing procedure is highly important for ensuring that each branch of the duct system receives the correct (designed) amount of air volume flow rate.

The project is organized in 3 main parts which reflect the approach followed for the completion of this project. The first part is dealing with the presentation and explanation of the theory, which will be put to practice later on. The second part is devoted in the preparation and design of the construction of the experimental unit while the third part denotes the preparation of laboratory instruction sheets for experiments to be carried out with the air ducting unit.

The main conclusions from this project is that although balancing of ducts is a part of a constructional engineer in every day's life it is not appreciated as much as it should. And believe it or not things may not be as they look like to be from the first glance. This is the reason why an experimental simulating unit is a must for the training of a proper engineer!

ACKNOWLEDGEMENTS

I first selected this project because it seemed like an interest project to deal with. Now that I have finished it I still believe the same thing but even stronger than before! Through this project I learned more than I was hoping for.

The field of air duct systems, in Cyprus more specifically, has not been used before in these levels as it is being used today. People realised the significance of a correct and complete A/C system and the increase it can add up to in human productivity. It has endless potentials for improvement and there are people that really know their way around the subject and can really contribute in the field.

Some of them that helped me a lot in my attempt for this project are my friend Tryfonas Xristodoulou and my Supervisor Theodoros Symeou. I thank both very much for their valuable guidance through every step for this project.

My appreciation also extends to my father Mr. Artemo Kountouri for his help in assembling the experimental unit.

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INTRODUCTION

Ultior goal of this project is the design and construction of an air duct unit for experiments on air pressure balancing.

I will try to present and explain the theory behind the flow of air in an air ducting systems and finally reach to the best way of constructing the unit. This is not an easy task due to the difficult-to-understand phenomena contained in that theory. The project assumes that a certain level of knowledge of mathematical and engineering curricula is possessed by the reader in order to understand the equations and laws used. Their proof is not considered to be part or purpose of this project. The reader is encouraged to study further the fluid mechanics theory, by looking into the given references.

The heating and cooling system is supposed to create a comfortable artificial environment for over 50 percent of the year. This is the reason that air conditioning, though in the past was considered luxury, has become nowadays a necessity! This need for human comfort led mechanical engineers in the development of various ways to achieve the functions of air conditioning, which are:

1. Temperature of the surrounding air
2. Humidity of the air
3. Ventilation and
4. Filtering of air in space

Air conditioning systems developed can be separated into three categories:

1. All-air systems
2. Air and water systems
3. All water systems

From the above one can see that air circulation for 1st and 2nd type is necessary. But for an air conditioning system to be "complete" all the four above functions should be satisfied, including the ventilation requirements.

Ventilation, although sometimes underestimated, is very important for human comfort because of the reasons listed below:

- Supply of O₂ for breathing
- Remove products of respiration
- Remove smells, odours, smokes
- Remove other dangerous substances produced by industrial processes (welding etc)
- To obtain a cooling feeling

Therefore even for the 3rd type of air conditioning system ducting of air is a must!

The main disadvantage of air ducting systems is that when a fan is serving several duct branches, it is necessary to carry out a balancing exercise to ensure that each branch receives the correct (design) flow.

Since adjusting a damper on one branch will also affect the flows in the other branches, it is clear that the balancing must be carried out in a systematic manner if it is to be accomplished in a reasonably short period of time.

The method that will be described in the next chapters is called the proportional ratio method, and in essence, it is the same method that is used for balancing water systems.

Ventilation and exhaust system duct sizing has quite a few more wrinkles than one might think from the first glance. It is considered in general an easy task and not a very important one. But in the contrary it is an important parameter and not easy, when treated tactless.

In fact we could say that it's a vital one for the proper functionality of the system and therefore the final goal, the human comfort.

The following chapters also contain the data from which the selection of the appropriate materials and equipment, for the construction of the experimental unit, was made.