All you need to know about air conditioning

The how and why of heating, ventilating and air conditioning systems in a nutshell

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COLOPHON

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Illustrations
In the case no source is identified, the author is responsible.

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THANKS

This guide is born out of course material for the second year students of the faculty of Architecture and the Built Environment and a previous publication ‘A clean and energy-efficient heating, ventilating and air-conditioning system’, published by TNO Building and Construction Research in 2004.

Because of the success of ‘All you need to know about indoor air’, the same format is chosen: a small booklet with lots of illustrations that you can easily bring along, and is suitable for a broader audience.

I would like to specially thank Peter van den Engel, parttime employed at the Delft University of Technology as lecturer Building Services, for his critical input.

Enjoy reading!

Philomena Bluyssen

PREFACE

Air conditioning has a negative image: it would make us less tolerable to temperature changes; it produces background noise; it causes draught; it can pollute the air; it is difficult to handle; it needs maintenance; it uses a lot of energy; etc. The question is arising whether a full air conditioning system, or even only a mechanical supply, is better than natural ventilation to be exposed to or not. Should we keep trying to apply non-mechanical, (preferable non-energy using) systems, or are we allowed to select a mix-mode?

In an ideal situation, a heating, ventilating and air conditioning (HVAC) system should deliver 'healthy air' at a specific temperature and humidity, causing the least possible nuisance (smell, noise, draught, temperature differences), using the least possible energy. However, HVAC-systems and their components can pollute the supply air to a significant extent and can therefore cause health problems and discomfort, such as Sick Building Syndrome symptoms (e.g. irritation of eyes, airways and skin, headaches, tiredness), comfort-related problems (dry air, odour, draught, too cold, too warm, temperature changes, noise) and health-related problems (allergies, hypersensitivities, inflammation). Moreover, the energy use of an HVAC-system represents a considerable part of the total energy use of a building. However, it is economically feasible to construct and maintain HVAC-systems that are well-designed from an energy perspective and also realise a healthy and comfortable indoor environment.

Chapter 1 answers the question ‘Why are HVAC-systems needed?’

Chapter 2 discusses the question ‘What do HVAC-systems do?’ along the functionalities that a system can have: cleaning, transportation (moving air), (de)humidification, heating and/or cooling, heat recovery, distribution of air in a space, and the control of the airflow, temperature and humidity.

Then chapter 3 discusses ‘What is important to know?’ for a number of components during design and use of HVAC-systems, in order to keep the indoor environment healthy and comfortable: air filters, air ducts, air humidifiers, heating and cooling systems, heat recovery systems, air grilles and control systems. Tips for design and use to realise a good indoor environmental quality are presented, as well as tips for optimisation of energy use.

Finally, chapter 4 explains stepwise what you need to do when you have to choose between natural and/or mechanical ventilation. Both source control and limited use of heating and cooling are emphasized.

The recommendations and information presented in this guide, are useful for architects, installers, consultants, and for persons who are responsible for the maintenance of HVAC-systems in a non-industrial environment: for example your own living environment, at school or in an office environment!

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01 Why HVAC-systems?

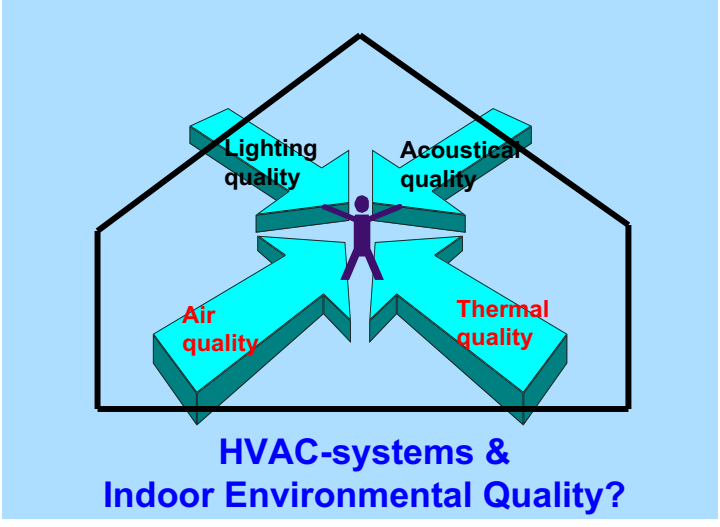
1.1 Introduction

What is the purpose of HVAC-systems?

HVAC-systems are meant to make and keep the indoor environment healthy and comfortable, in other words to always create the best possible indoor environmental quality.

HVAC-systems are meant to contribute to a good air quality and thermal quality, without compromising the quality of lighting or acoustical quality.

HVAC-systems are meant to control the thermal quality and the air quality, through ventilation, air cleaning, heating, cooling and humidification or dehumidification of the air.



2.1 Introduction

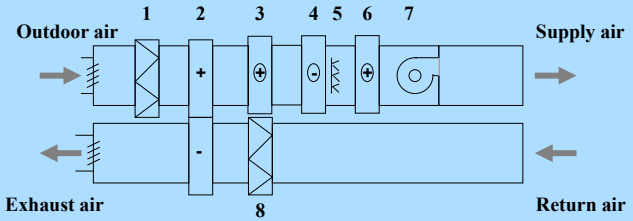
A ventilation system, central and/or local, can have more than one function: air supply/exhaust, cleaning, heating/cooling, humidification/dehumidification, and heat recovery.

Depending on the required functions, a ventilation system can have different forms:

- Mechanical exhaust only.
- Mechanical exhaust and supply (balanced or not).
- Mechanical exhaust and supply with air conditioning.
- Mechanical exhaust and supply with air conditioning and heat recovery (and in some cases recirculation).

The principal components of an AHU for the last option are shown below. Next to those components, a complete HVAC-system can contain: dehumidification, ducts, sound attenuators, control systems, supply and exhaust grilles, and locally controlled after-heating and cooling devices.

+heating +cooling +humidification +heat recovery



1 = filter supply air
2 = heat recovery
3 = pre-heater
4 = cooling coil
5 = humidifier
6 = after heater (coil)
7 = ventilator
8 = filter return air

Principle components of an HVAC-system