

VARIABLE AIR VOLUME

Equations ① and ② can be managed by changing the air flow rate

$$q_p = G_I c_p (t_a - t_I) \quad \text{①}$$

$$G_{vp} = G_I (x_a - x_I) \quad \text{②}$$

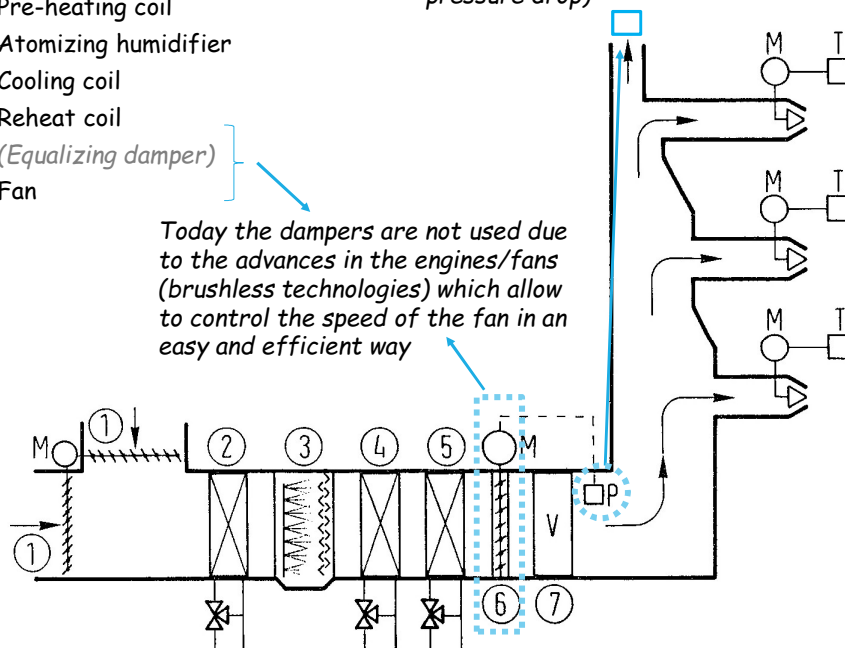
Terminal units *with variable geometry* are activated by means of a *servomotor* actuated by a thermostat

The air flows where it is required

Less air flowing in the ducts

1. Equalizing dampers
2. Pre-heating coil
3. Atomizing humidifier
4. Cooling coil
5. Reheat coil
6. (Equalizing damper)
7. Fan

Usually in the farthest point (largest pressure drop)



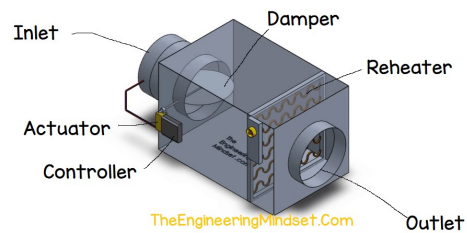
Today the dampers are not used due to the advances in the engines/fans (brushless technologies) which allow to control the speed of the fan in an easy and efficient way

It is important to control the pressure in the main duct (hence on the fan speed) when the damper is activated in order to balance the whole duct system.

This way the variation of the air flow in a zone will not affect the flow rate in other zones.

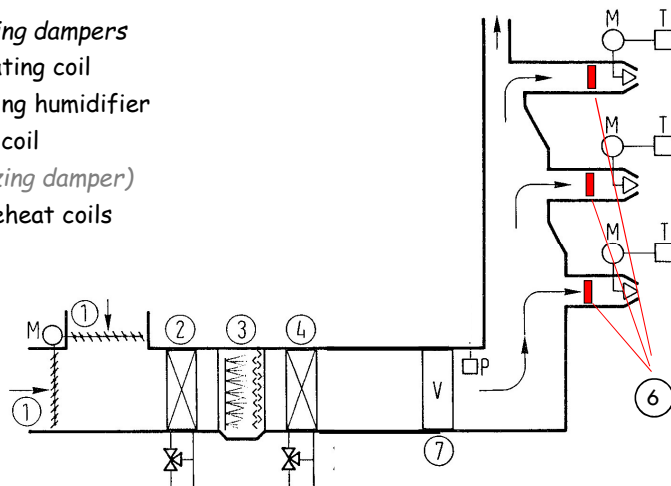
Hence it is requested that the whole system is an integrated solution.

The flow rate can be lowered down to 20-30% of nominal value. Lowering the rate can lead to a poor IAQ risk. For this purpose equalizing dampers are placed in the fresh air circuit and in the recirculation circuit



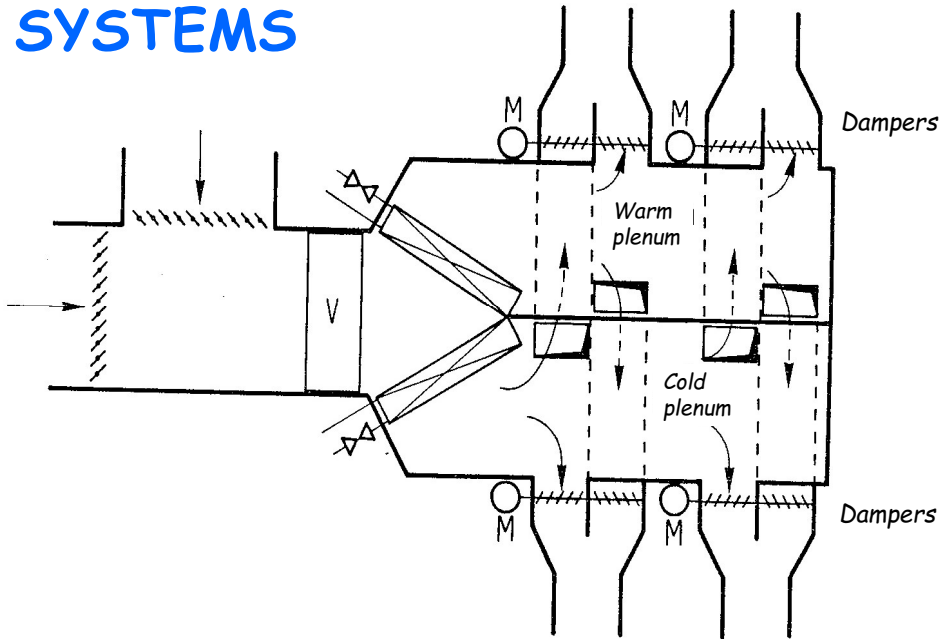
MULTIZONE SYSTEMS WITH REHEAT COILS AND VAV

1. Equalizing dampers
2. Pre-heating coil
3. Atomizing humidifier
4. Cooling coil
5. (Equalizing damper)
6. Local reheat coils
7. Fan

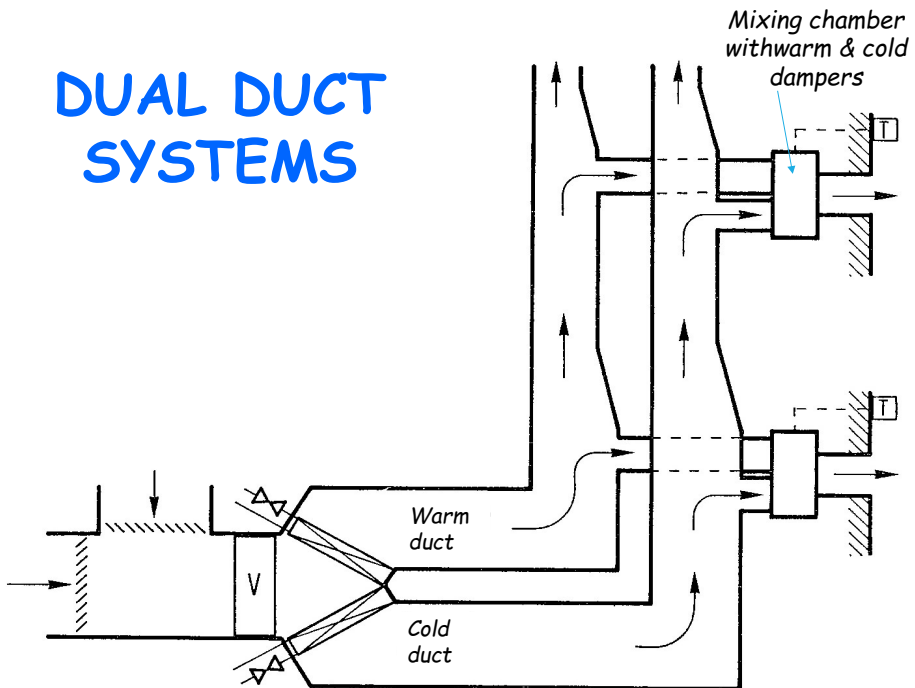


Control strategy: flow rate first and then reheat coil

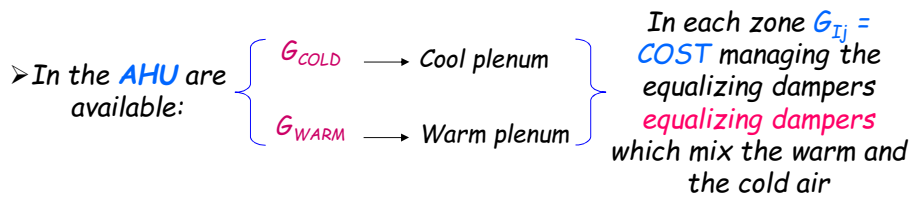
DUAL PLENUM SYSTEMS



DUAL DUCT SYSTEMS



➤ Low installation costs



➤ The inlet point **I** is easy to keep

➤ Small changes in



Too low (winter)

Resulting by the two mixing flow rates

Humidifier in the recirculation system

t warm plenum:

- Summer → t_{ext}
- Winter → $t_a + 20 \div 25 \text{ } ^\circ\text{C}$

t cold plenum:

CONSTANT = $12 \div 15 \text{ } ^\circ\text{C}$ →

In winter the cooling coil does not work and the air flow rate varies
 $G_{EST} \rightarrow IAQ$

In cold climates to avoid too low temperatures



Preheating coils before the fan or heat recovery unit

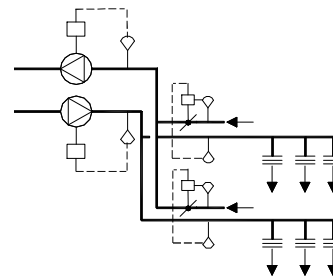
Variable Air Ventilation (VAV) & Demand Control Ventilation (DCV)

DCV is a particular type of VAV

It is a VAV with automatic control on demand → DCV

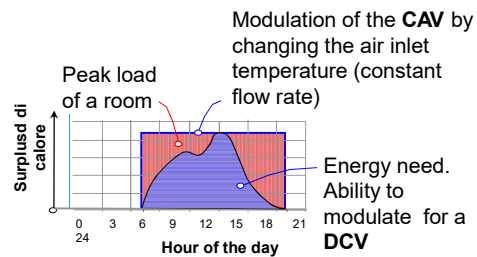
VAV
 Ventilation with variable flow rate
 VAV with automatic control depending on the demand → DCV

Different parameters can be set dealing with thermal comfort and/or IAQ

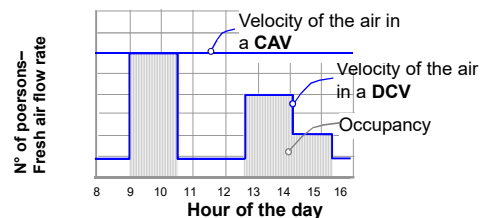


DCV SYSTEM VS. CAV SYSTEM

- **DCV for the comfort control** (heating/cooling load)

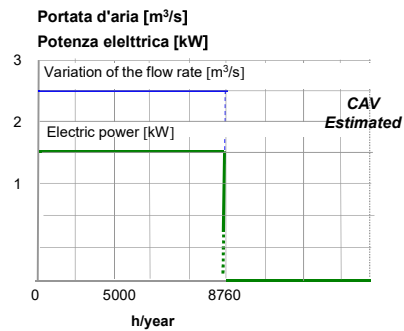
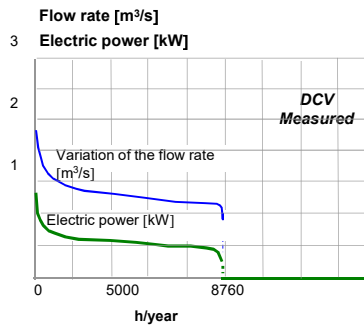


- **DCV for the IAQ control** (pollutant removal)
 A proper marker is the CO₂



Advantages of a DCV

Possibility to modulate the flow rate of the air all year round (i less electric energy for the auxiliaries)



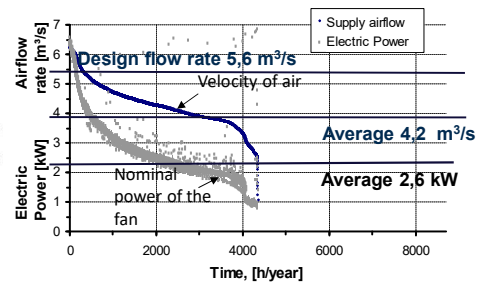
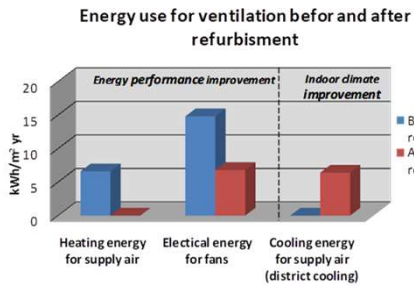
APPLICATIONS OF A DCV

- For buildings with variable loads
 - ✓ Conference centres/auditorium;
 - ✓ Offices;
 - ✓ Restaurants;
 - ✓ Theatres;
 - ✓ Schools
 - ✓ ...
- The greater the variation of the loads, the larger the energy saving



EXAMPLE OF DCV

Retrofit of an office building
(CAV → DCV)
3500 m² with 107 offices



EXAMPLE OF DCV

Retrofit of an office building
(Administrative offices of a University)
2500 m² with 76 offices

