Lindab

VAV & DCV Solutions

VAV & DCV Solutions

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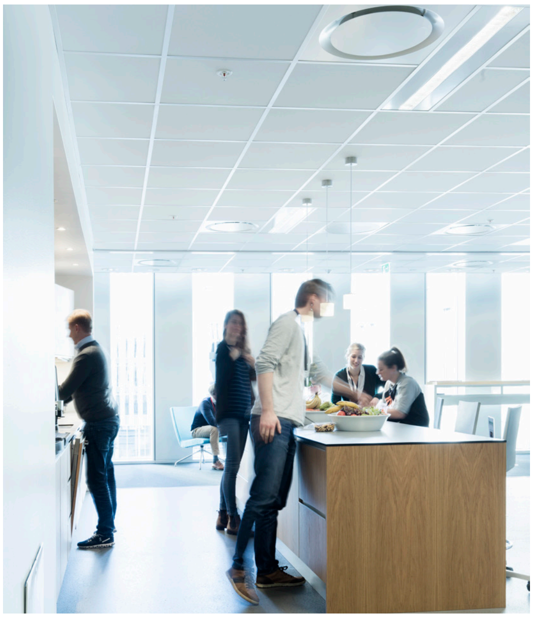

Introduction

This manual is divided into Supply, Extract and complete solution. The supply solution is further more divided after room type. Each of the solutions found in this manual has a short description.

Designing a VAV/DCV ventilation system.

Variable Air Volume & Demand Controlled Ventilation.

VAV is about only using the necessary airflow and energy to ventilate buildings.

When designing a VAV/DCV ventilation system, there are several ways of doing it.

First the use and indoor climate requests of the room must be determined. This is important before the regulation parameter(s) can be chosen. The most common regulation parameters are:

- Temperature
- CO_2
- Presence/occupancy
- Humidity

A temperature regulation is often enough in most of the rooms, because the indoor climate is mostly influenced by solar gains, people and equipment. On the other hand though, sometimes other sensors would be more relevant than a temperature sensor: CO_2 sensor (for rooms with high occupancy index), presence sensor (for rooms with discountinuous occupancy), humidity sensors (for rooms with high evaporation or high latent load).

How to ensure the correct airflow to each room ?

One of the biggest issues with VAV/DCV is the distribution of the air. To make sure that all rooms gets the correct airflow it is a good idea to have VAV airflow regulators to each room.

General information on VAV

VAV is acronym for ”Variable Air Volume”. VAV is a demand controlled ventilation, to be used when the loads in a building vary. On the other hand, in rooms with a changing number of people, an airflow regulation based on CO_2 concentration (a good air quality indicator) would give a more satisfactory indoor comfort. It is however often the thermal load, such as people, computers and sun, that is dimensioning the ventilation need in a room. These thermal loads will almost always vary throughout the day and the night. By maintaining a constant supply air temperature, lower than the room temperature and instead regulate the air flow in ratio to the desired room temperature, the demand controlled ventilation will compensate the heat load.

The variation of the airflow in the system is controlled by duct dampers or by motorized supply air diffusers.
A VAV system is suitable for both displacement ventilation systems, mixed ventilation systems, active chilled beams systems.

Description of regulation types

In VAV systems, it is a pre-requisite that the fans can be speed-controlled.
Furthermore the VAV-unit must be divided into zones/sections, typically one zone for each distribution air duct. These zones can be identified from two different principles: The airflow regulation or pressure regulation.

Airflow regulation

According the airflow regulation principle, the air flow is measured and regulated across the whole air duct system. The airflow is set to be able to vary between a preprogrammed minimum and maximum airflow. An electronic signal from a sensor (temperature, CO_2, presence) or BMS regulates the airflow within the set minimum and maximum airflow limits.

In airflow regulation, the right airflow will be achieved even when the pressure conditions in the air duct are changing, since the airflow regulator is independent of the pressure (and only requires a minimum pre-pressure).

This type of regulation is usually used for zone-regulation in connection with diffusers without dampers in mixed- or displacement systems. In case of a mixed ventilation system with terminals without damper, and a temperature difference above -8K between supply air and room temperature, there is a risk to get draughts due to the too cold air from the diffusers.

The airflow regulators have a minimum limit for the measuring of the airflow. The minimum airflow must not be set lower than the measurement limit for the velocity of approx. 0.7 m/s. Airflow regulation can be used in the distribution air duct both for supply air and extract, either with a parallel signal from a sensor or BMS or with a Master/Slave function. If for example an over- or under pressure in a room is desired, with respect to the surroundings, a Master/Slave function is advisable.

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Pressure regulation of air ducts

Pressure regulation in ducts can be used within an area where it is required to maintain a stable duct pressure or in areas where air pressure has to be kept under a certain limit.

Normally, it is the distribution air duct on the supply air side which is regulated for pressure. A pressure regulation entails that a constant static pressure is maintained in the air duct. The static pressure is measured by a probe mounted inside the air duct. The probe is connected by a pipe to an electronic unit (pressure regulator) which registers the static pressure in the air duct with a membrane sensor unit.

A pressure regulation in the air duct will ensure stable pressure conditions in the zone, and therefore good conditions for controlling air duct dampers.

No matter the unit type however, the pressure loss in the zones air duct has to be taken into consideration, in order to obtain a similar if not identical pressure at all branches to the connection ducts. As a general rule, the pressure loss in the air duct from the first branch to the last branch should not exceed approx. 40% of total static pressure.

Mixed ventilation

In mixed ventilation the air is supplied with a relatively high velocity outside the occupied zone, usually from the ceiling or the wall. The high velocity of the supplied air means, that a considerable amount of room-air is circulated as well.
The velocity of the supplied air should be kept at a level which ensures that the mixing is effective, but at the same time ensures that the air velocity has fallen to the required level by the time it reaches the occupied zone. This makes demands on the efficiency of the units used as regards to velocity and mixing capacity.
An increase in the supplied air velocity will cause an increase in the sound level. Requirements for a low sound level consequently means a limit on the diffusers efficiency.
The temperature and the contamination concentration is roughly the same throughout the room, for both isothermal and cold air.
Mixed ventilation is mostly unaffected by outside influences and can be used for both heating and cooling needs.

Supply of cold air

As the cold air is heavier than the warm air, in case of high thermal loads there could be an excessive air velocity in the occupied zone. The higher the load, the bigger the risk. The air jets from diffusers (normally horizontal) and the convection streams from the heating sources (people, lighting, machines) result in a velocity in the occupied zone, which in addition to the supplied air velocity from the diffuser, depends on the removed effect per square meter (W/m^2), the distribution on the individual diffusers and the diffusers jet pattern.

The supply of both hot air (heating phase) and cold air (cooling phase) in the same diffuser, from the ceiling can normally not fulfil all requirements for temperature gradient, ventilation efficiency and velocity in the occupied zone at the same time.

Connecting the solution

When the design for the rooms have been made, then it is time to consider a control system. The proposed solutions in this manual are all fitted to either stand-alone or be part of a larger control system.

Stand-alone
A stand-alone solution consists of an individual room controller in each room. For this type of VAV system it is recommended to control the AHU fans with pressure control.

BMS
Lindab room controllers and many of the actuators can communicate via bus communication. The solutions showed can therefore be integrated in a larger BMS system with MODbus, BACnet or KNX as standard.

Lindab Pascal
At Lindab we have designed our own DCV system fitted to create a simple and successful system solution. Read more about Lindab Pascal here:

Link to PASCAL

AHU fan control

In the past it has been customary to build VAV-system with a constant pressure AHU fan control. This is no longer adviceable, due to unnecessarry pressure in duct when air demands are low.

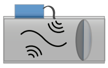
To ensure a low energy consumption in the AHU fans, it is recommended to optimize the fan speed. Combined with airflow regulators in each room it is possiple to optimize the airflow from the fans to meet the exact demand in the building.
It is advisable to vary the fan speed between a fixed minimum and maximum main duct pressure. This ensures full control of the main duct pressure and minimizes the pressure losses.

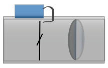
Fan optimization is a standard function in Lindab Pascal.

VAV & DCV Solutions

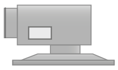
Symbol and cable overview


FTMU
Airflow & temperature measuring (Ultralink)

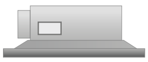

FTCU
Airflow regulator and temperature measuring (Ultralink)


VRU
Airflow regulator


Silencer
Sound attenuator

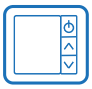

MBV with ceiling diffuser
Plenum box, airflow regulator

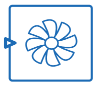

DBV
Straight through airflow regulator


ACB
Active Chilled Beam


OLR
Pressure control valve


Water actuator


Room controller


Supply fan
Extract fan


Extract airflow


Supply airflow


Presence sensor


Humidity sensor

CO_2 sensor


Temperature sensor (extern)

2-10 V flow signal

RJ45 Signal cable

VAV & DCV Solutions

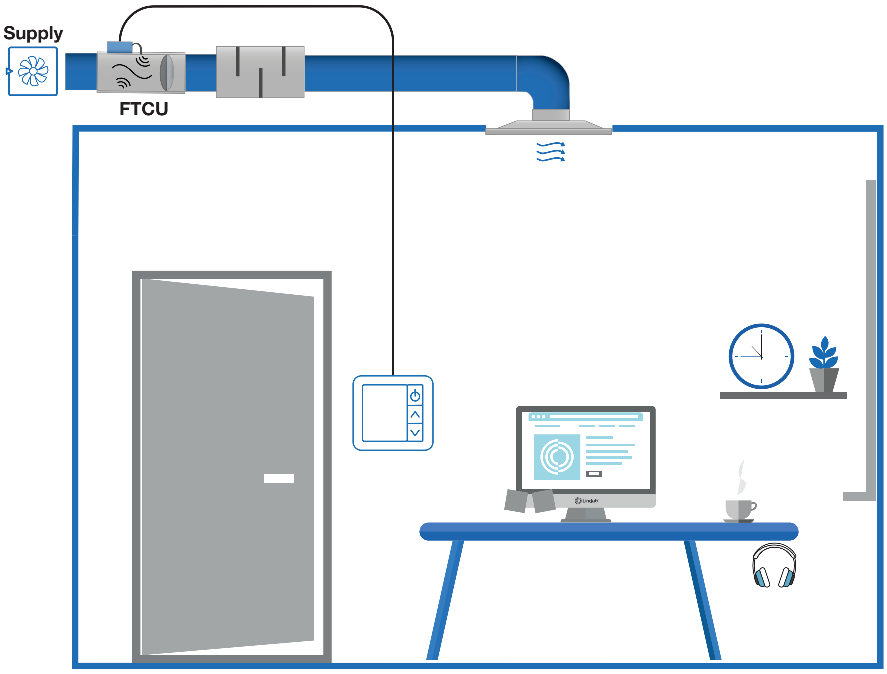
Supply Solutions

1. Single office solution

This chapter presents different solution proposals to create VAV/DCV ventilation in single offices. With single office it is intendend an office that has low personal load and low variation in use. There will be various suggestions for the supply part of the system.

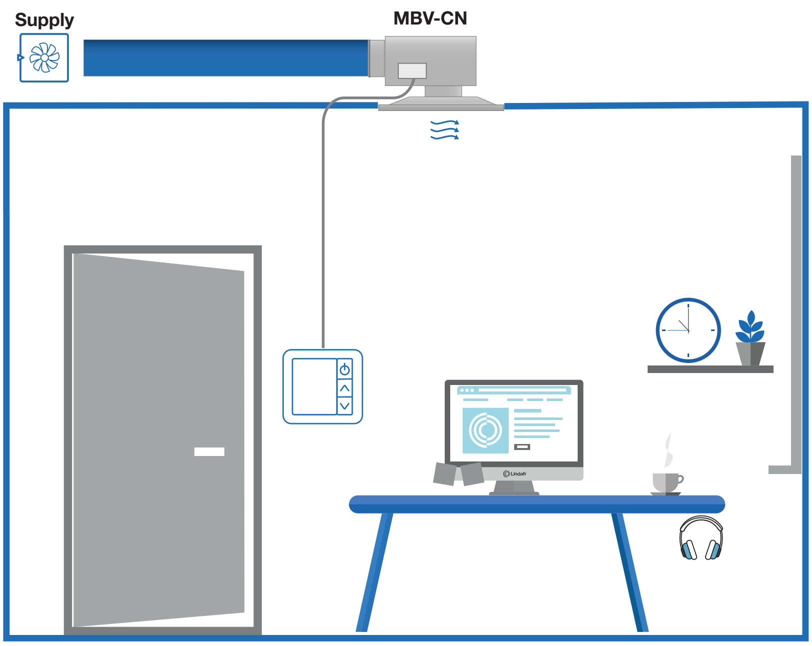
Solution 1A

Room controller with temperature regulation, where the supplied airflow is controlled with a FTCU.



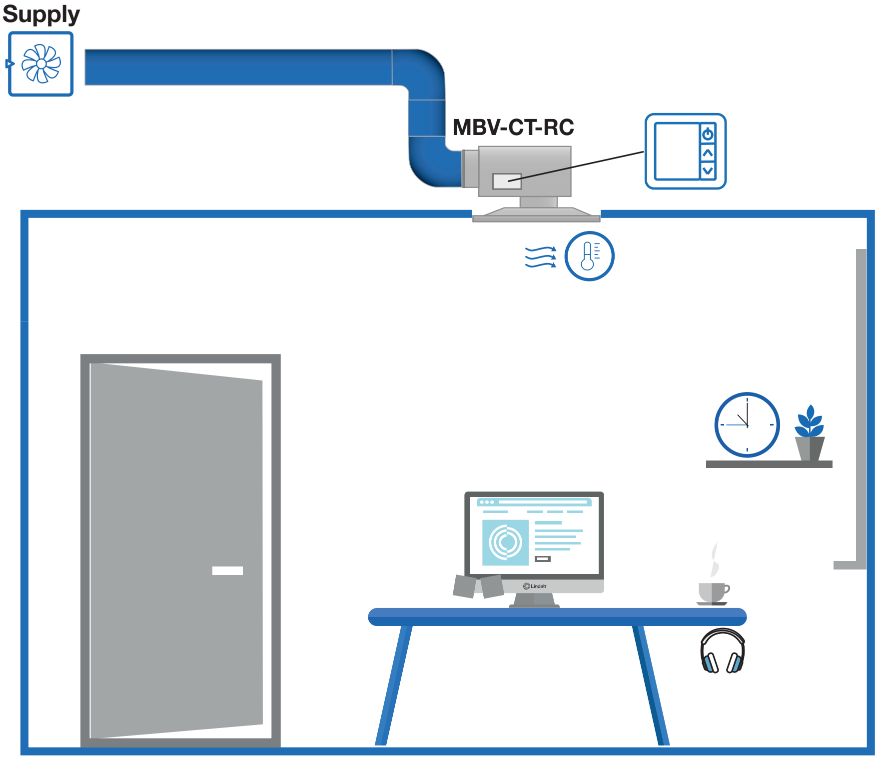
Solution 1B

Room controller with temperature regulation, where the supplied airflow is controlled with a MBV.

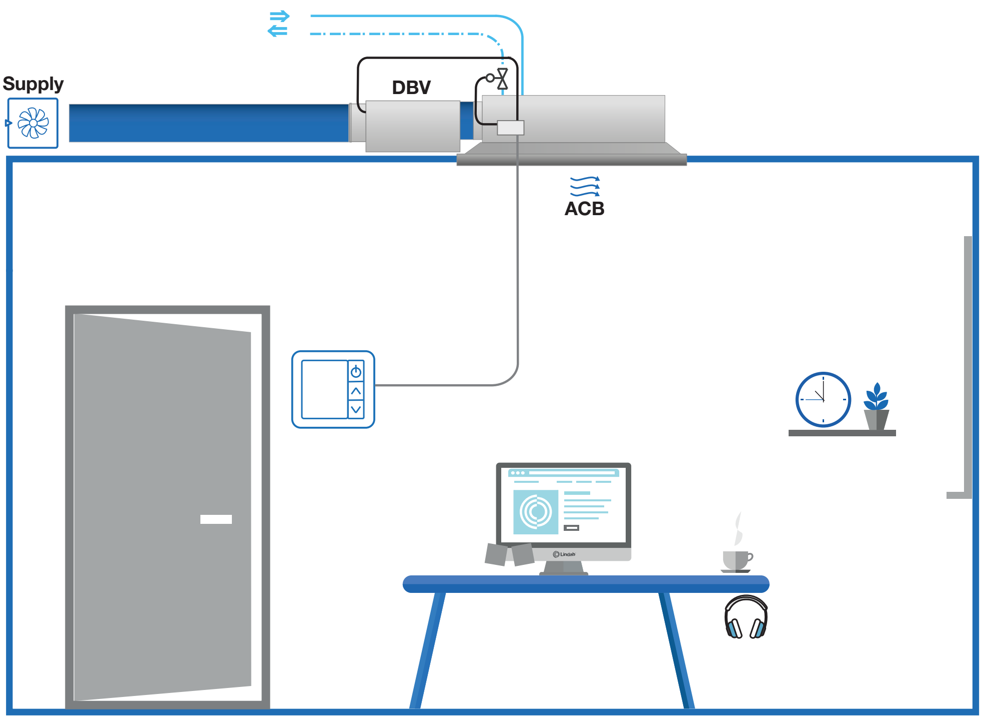


VAV & DCV Solutions

Solution 1C
Room controller mounted on MBV.
With temperature regulation from integrated sensor in LCP ceilling diffuser.



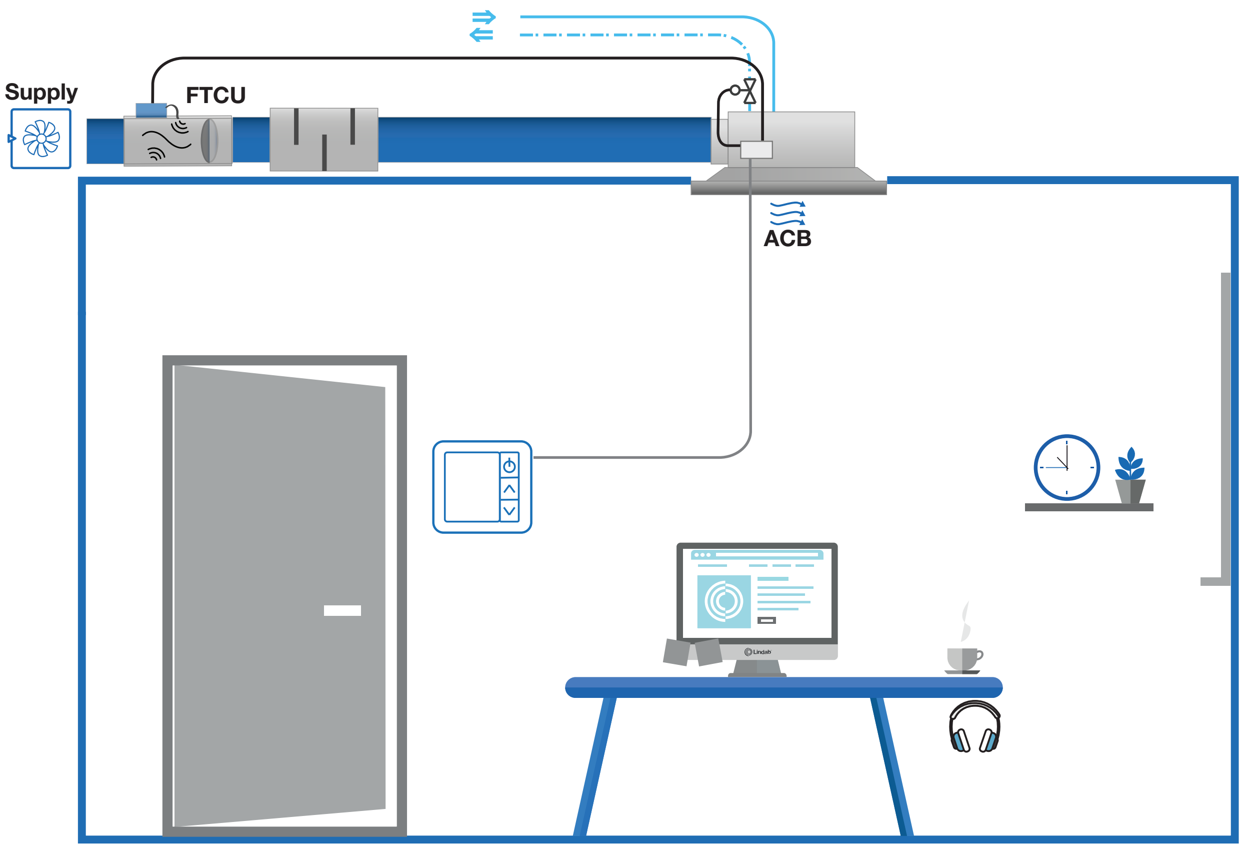
Solution 1D
Room controller with temperature regulation, where the supplied airflow is controlled with a DBV in combination with an active chilled beam, responsible for the water flow regulation.



VAV & DCV Solutions

Solution 1E

Room controller with temperature regulation, where the supplied airflow is controlled with a FTCU in combination with an active chilled beam, responsible for the water flow regulation.



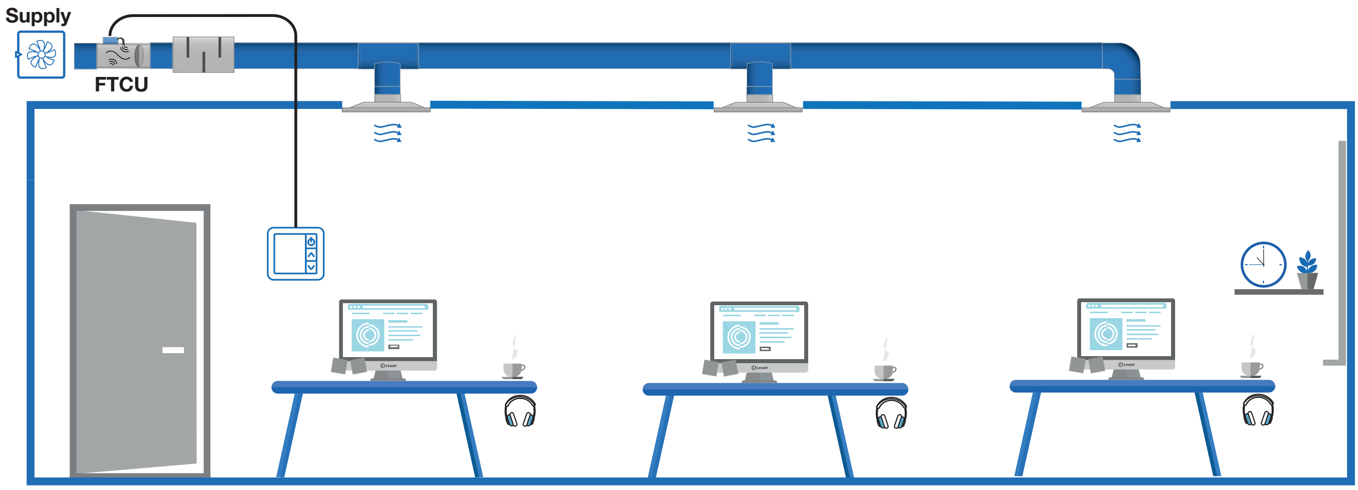
VAV & DCV Solutions

2. Landscape office

With landscape office it is intendend an office that has medium personal load and medium variation in use, with a bigger floor surface compared to a single office.
This chapter presents different solution proposals to create VAV/DCV ventilation in landscape offices.
There will be various suggestions for the supply part of the system.

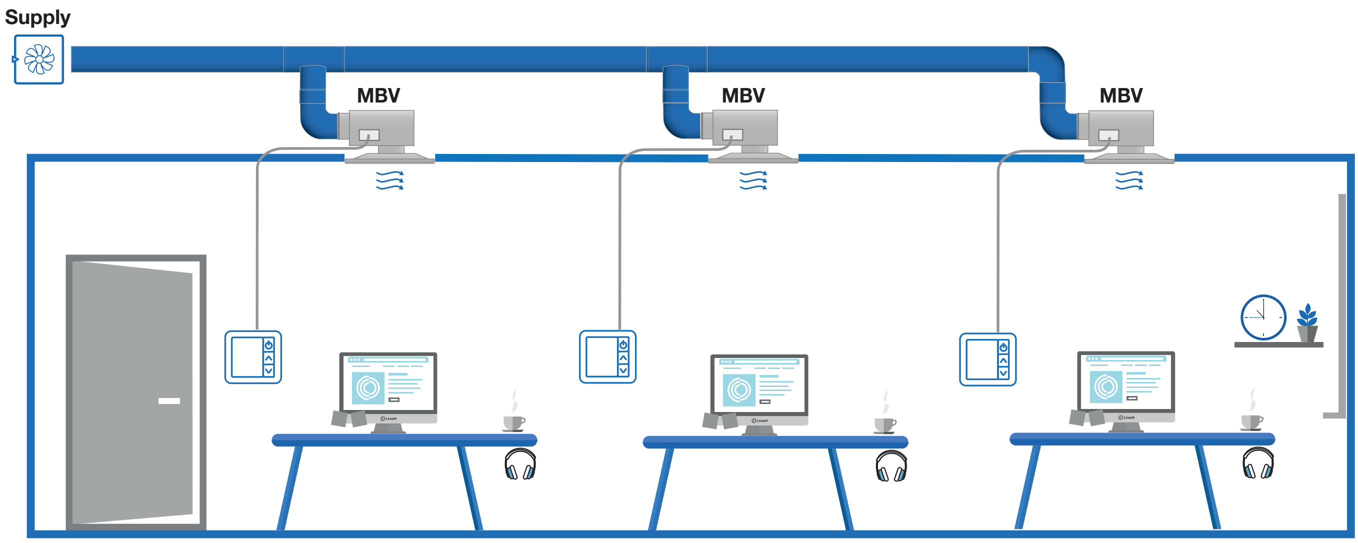
Solution 2A

Room controller with temperature regulation, where the supplied airflow is controlled with a FTCU.

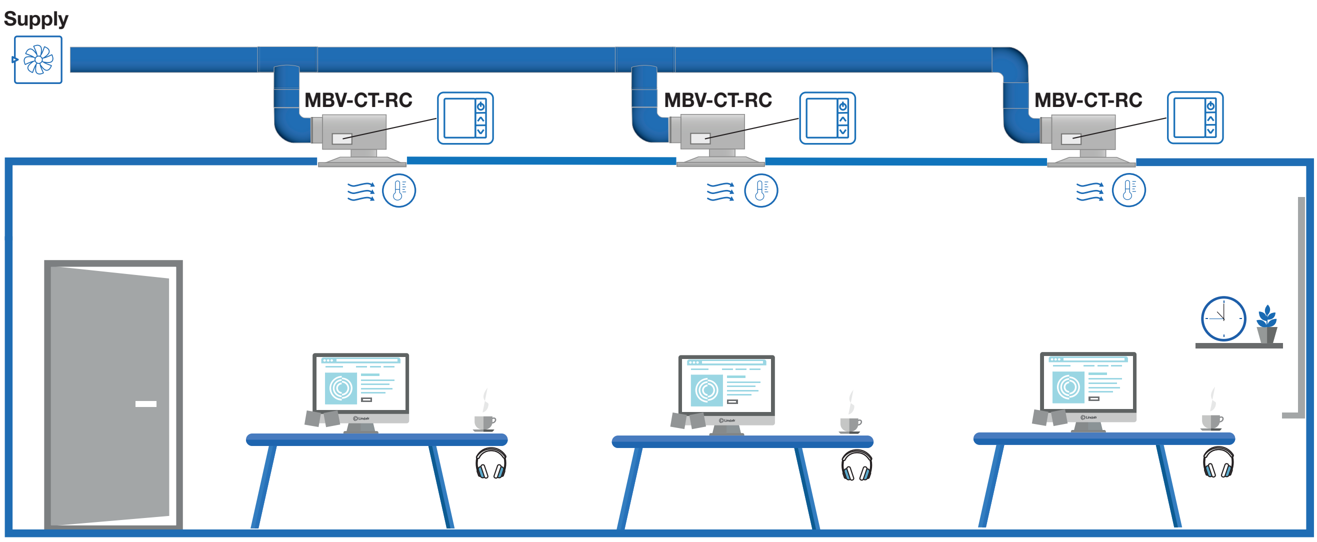


VAV & DCV Solutions

Solution 2C
Individual room controllers with temperature regulation. Controlling supply airflow to seperate temperature zones with MBVs.



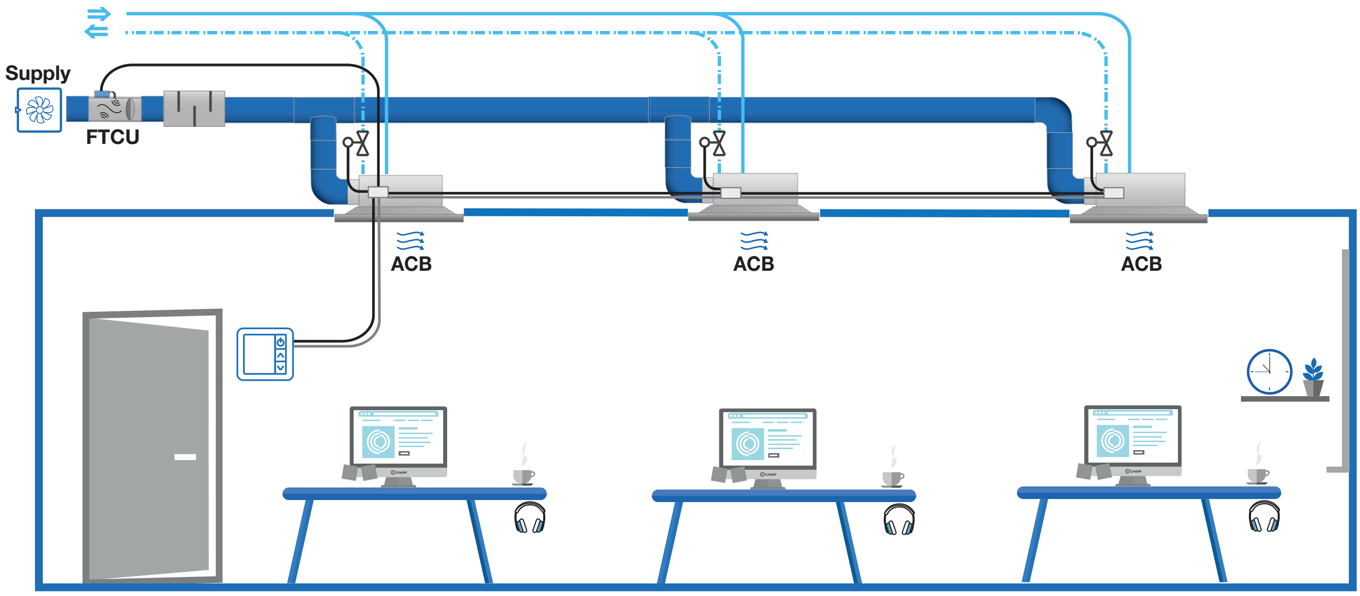
Solution 2D
Individual temperature-zones. Room controller mounted on MBV.
With temperature regulation from integrated sensor in LCP ceilling diffuser.



VAV & DCV Solutions

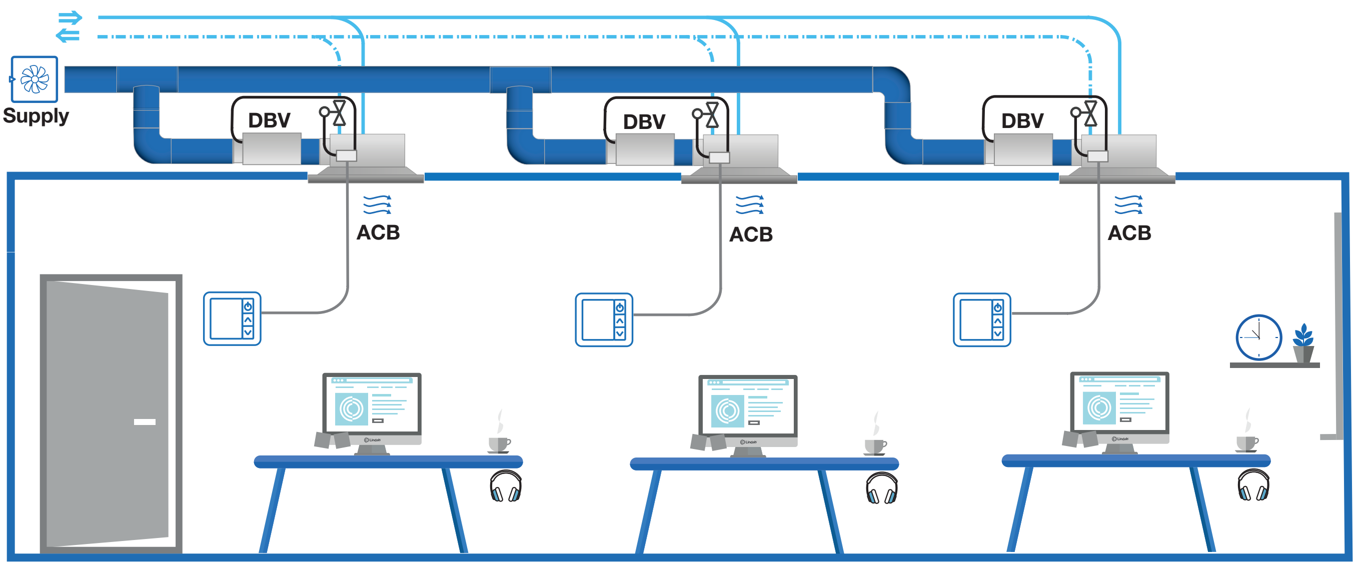
Solution 2E

Room controller with temperature regulation. Controlling air- and waterflows with active chilled beams and FTCU to common temperature zone.



Solution 2F

Room controllers with temperature regulation. Controlling air- and waterflows with active chilled beams and DBVs to individual temperature zones.



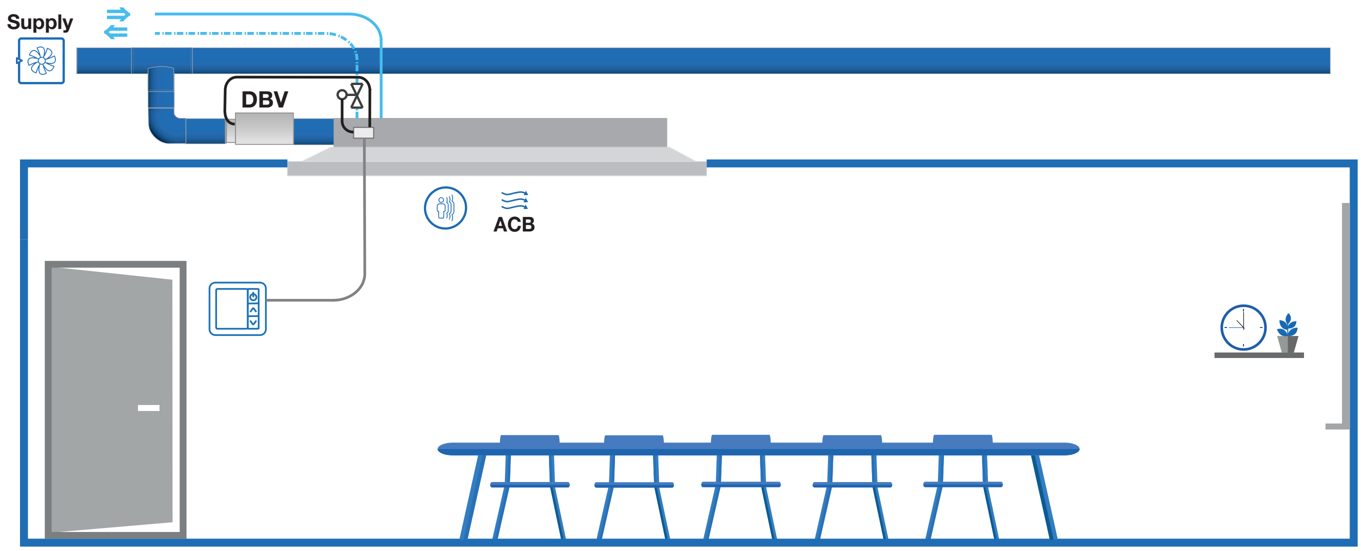
VAV & DCV Solutions

3. Conference room

With conference room it is intendend an office, or a room, that has high personal load and high variation in use.
This chapter presents different solution proposals to create VAV/DCV ventilation in conference rooms.
There will be various suggestions for the supply part of the system.

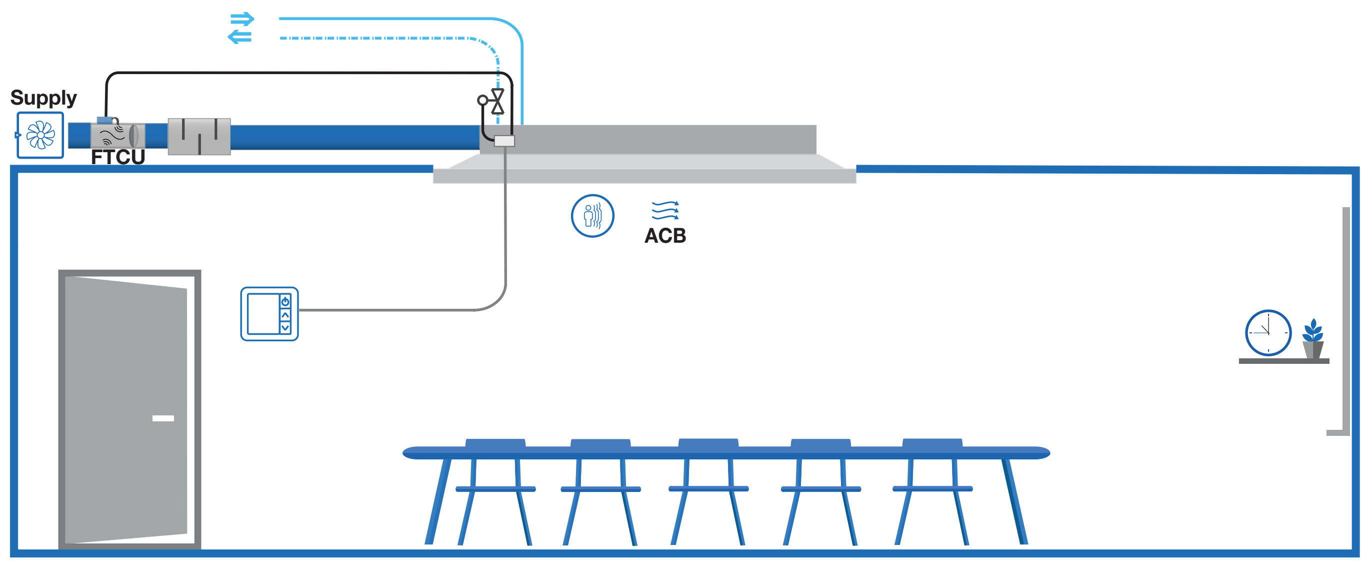
Solution 3A

Room controller with temperature regulation. Controlling air- and waterflows with active chilled beams and DBV to common temperature zone. ACB with integrated presence sensor to indicate occupancy.



Solution 3B

Room controller with temperature regulation. Controlling air- and waterflows with active chilled beams and FTCU to common temperature zone. ACB with integrated presence sensor to indicate occupancy.



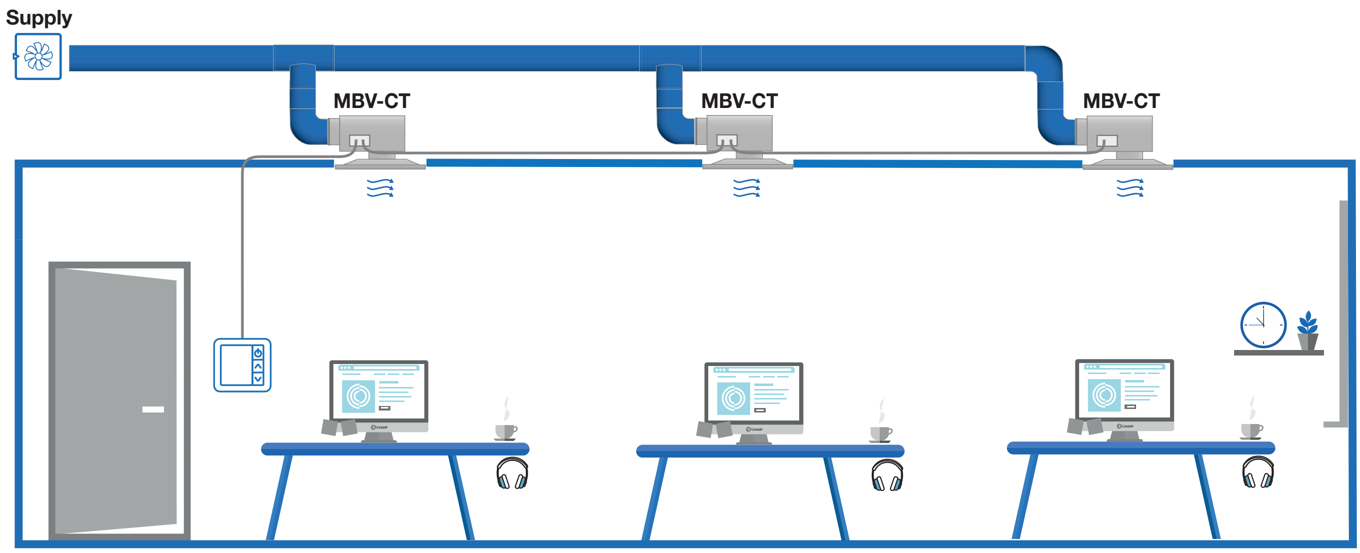
VAV & DCV Solutions

4. Class room

With classroom it is intended a room that has high personal load and low variation in use.
This chapter presents different solution proposals to create VAV/DCV ventilation in landscape offices.
There will be various suggestions for the Supply part of the system.

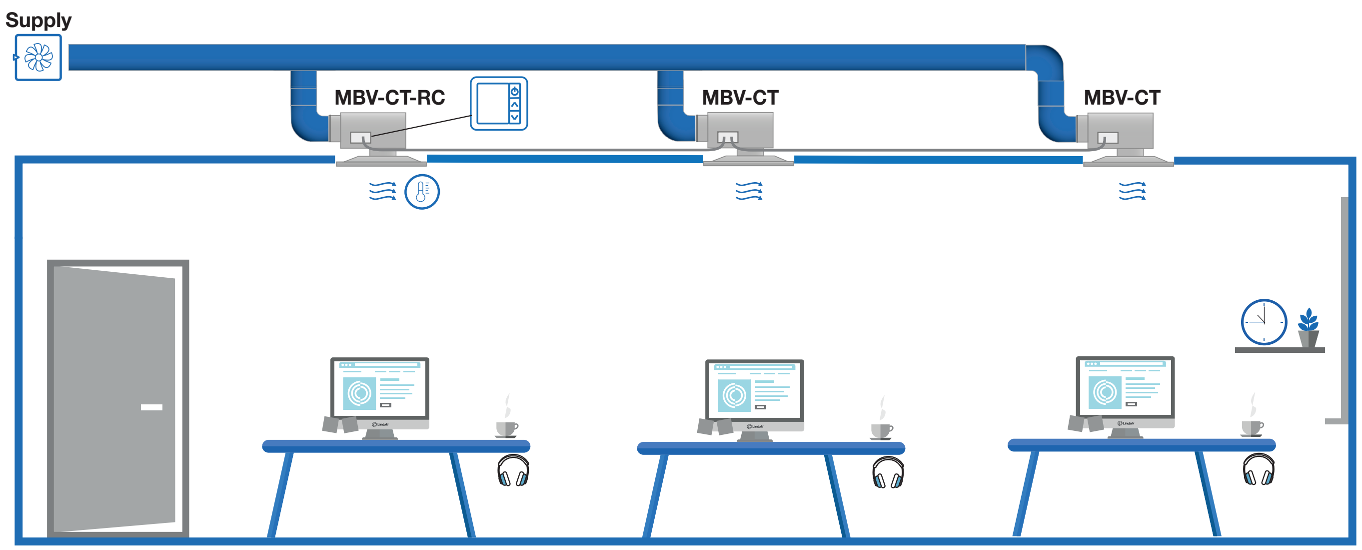
Solution 4A

Room controller with temperature regulation. Controlling airflow to large temperature zone with parallel connected MBVs.



Solution 4B

Room controller with temperature regulation. Controlling airflow to large temperature zone with parallel connected MBVs.



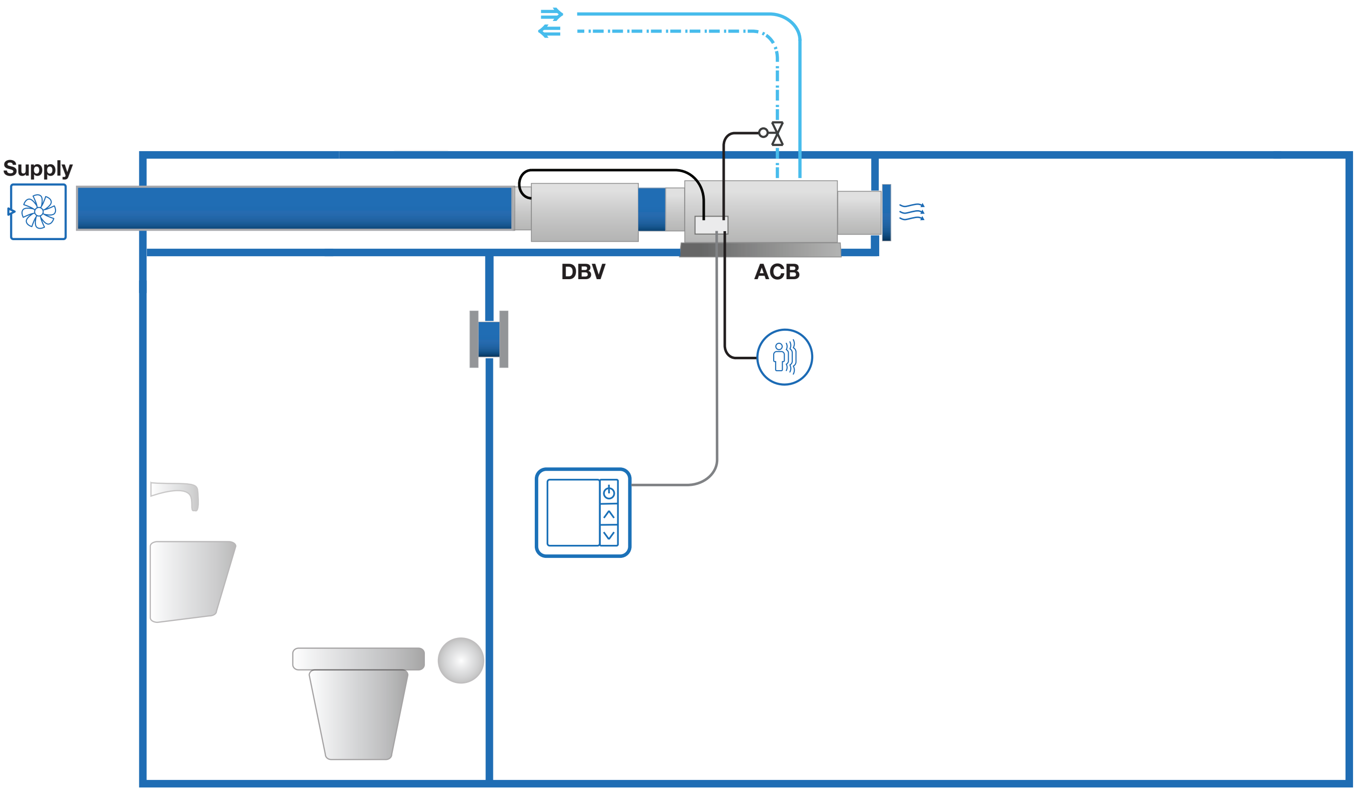
VAV & DCV Solutions

5. Hotel room

With hotel room it is intendend a room with low personal load and high variation in use.
This chapter presents different solution proposals to create VAV/DCV ventilation in Hotel rooms.

Solution 5A

Room controller with temperature regulation and presence sensor to indicate occupancy. Controlling air- and waterflow to Munio (ACB). Overflow valve to bathroom.



VAV & DCV Solutions

6. High ceiling room

In this chapter there are different solution proposals to create VAV/DCV ventilation in high ceiling room, only concerning the supply part of the system.
High ceiling rooms context can vary a lot: receptions, lecture hall, cinemas, etc. It is often difficult, due to the height of the room, to use mixed ventilation without having visible ducts and diffusers, but on the other hand the displacement ventilation is a good solution for this kind of application.

Displacement ventilation

In displacement ventilation, the air distribution is controlled and influenced by the thermal forces coming from the heating sources in the room. The air is supplied directly into the occupied zone at floor level - at low velocity and a cooling temperature. The air spreads across the floor, and displaces the hot, contaminated air, which is forced to the ceiling by the convection flow from the heating sources. Extract units should be placed in the ceiling, where a hot "contaminated" layer is formed. The ventilation efficiency of displacement ventilation is larger than the mixed ventilation owing to this stratification of the air. Increasesis increased with the ceiling height.

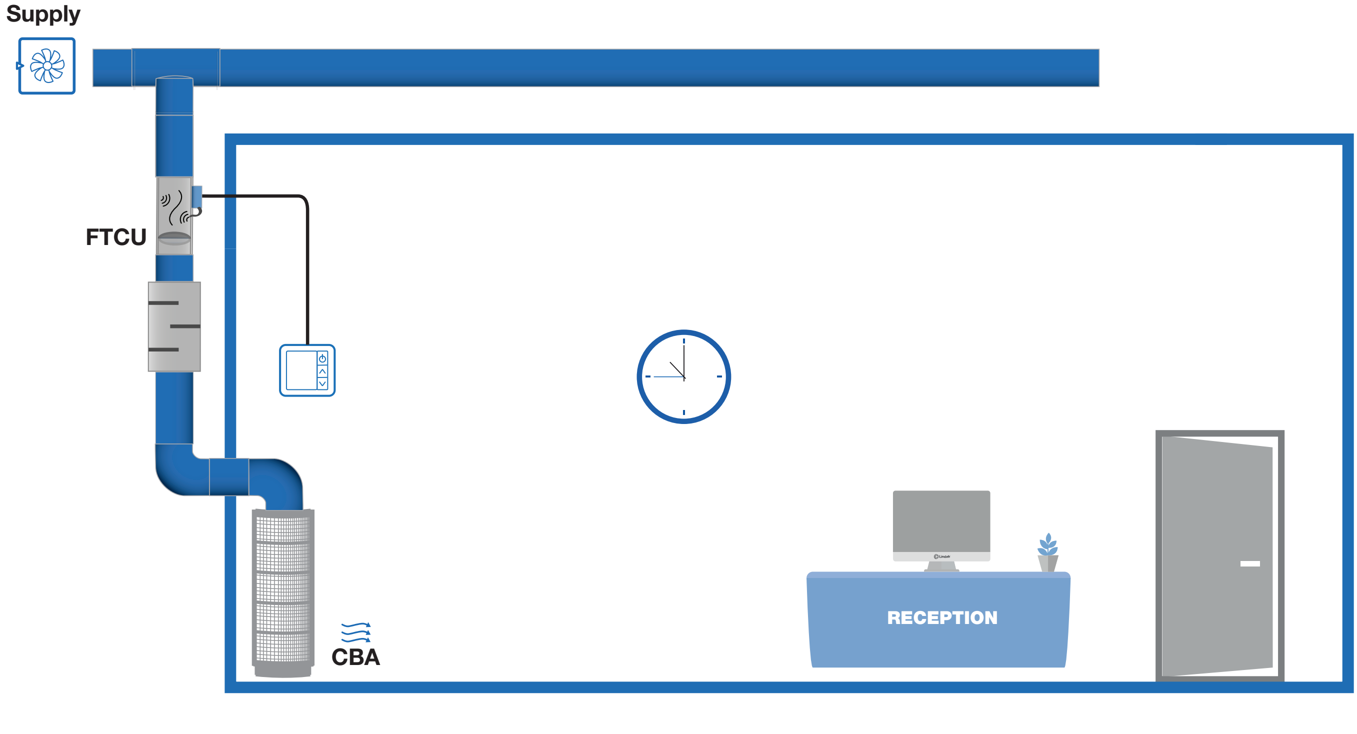
The increased temperature efficiency means, that cooling power can be saved, or that the cooling effect of the outside air can be used better, since the extract air is warmer and consequently will transport more effect from the room.

In normal circumstances displacement ventilation is not suitable for heating purposes.

The near-zone of the units depends primarily on the amount of supplied air, the cooling temperature and the placement of the unit. Within the recommended air flow range, the units size has no practical influence on the near-zone. The nearzone geometry can however be altered to suit the individual needs just by adjusting the nozzles.

Solution 6A

Displacement ventilation.
Room controller with temperature regulation. Controlling airflow with FTCU to displacement diffuser.



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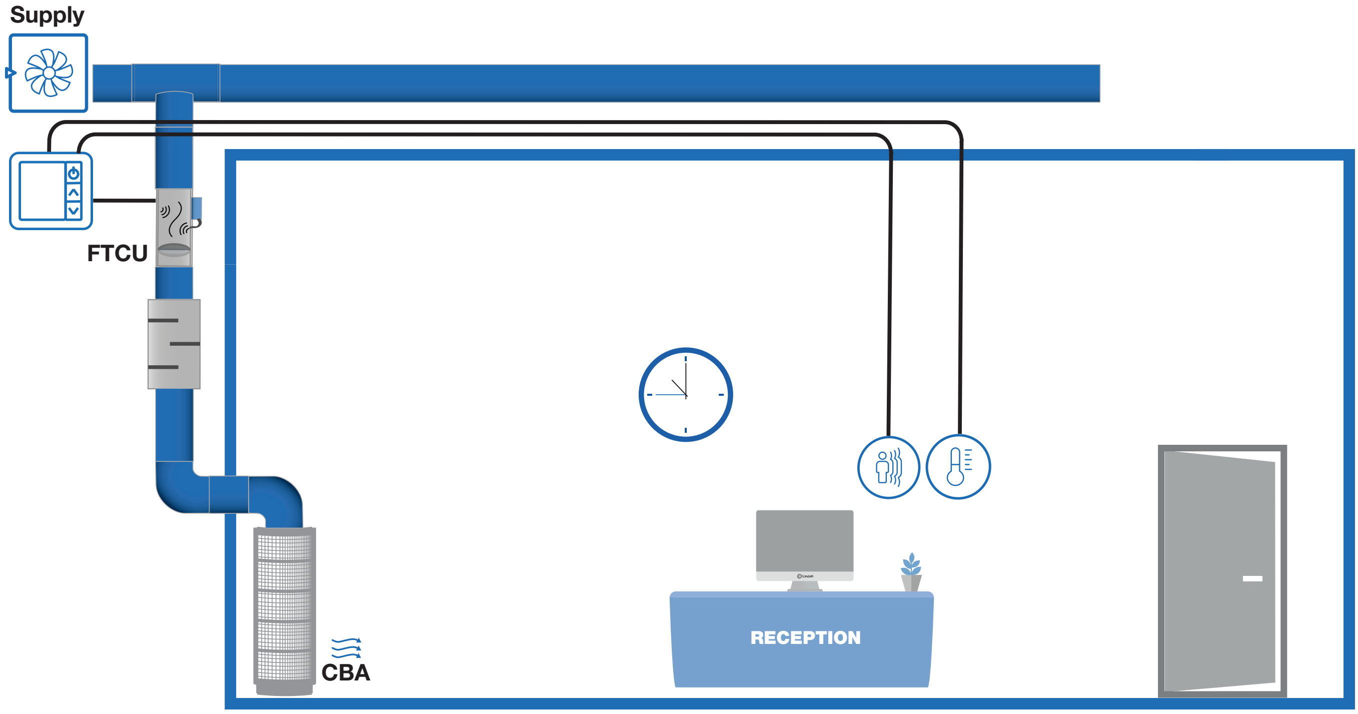
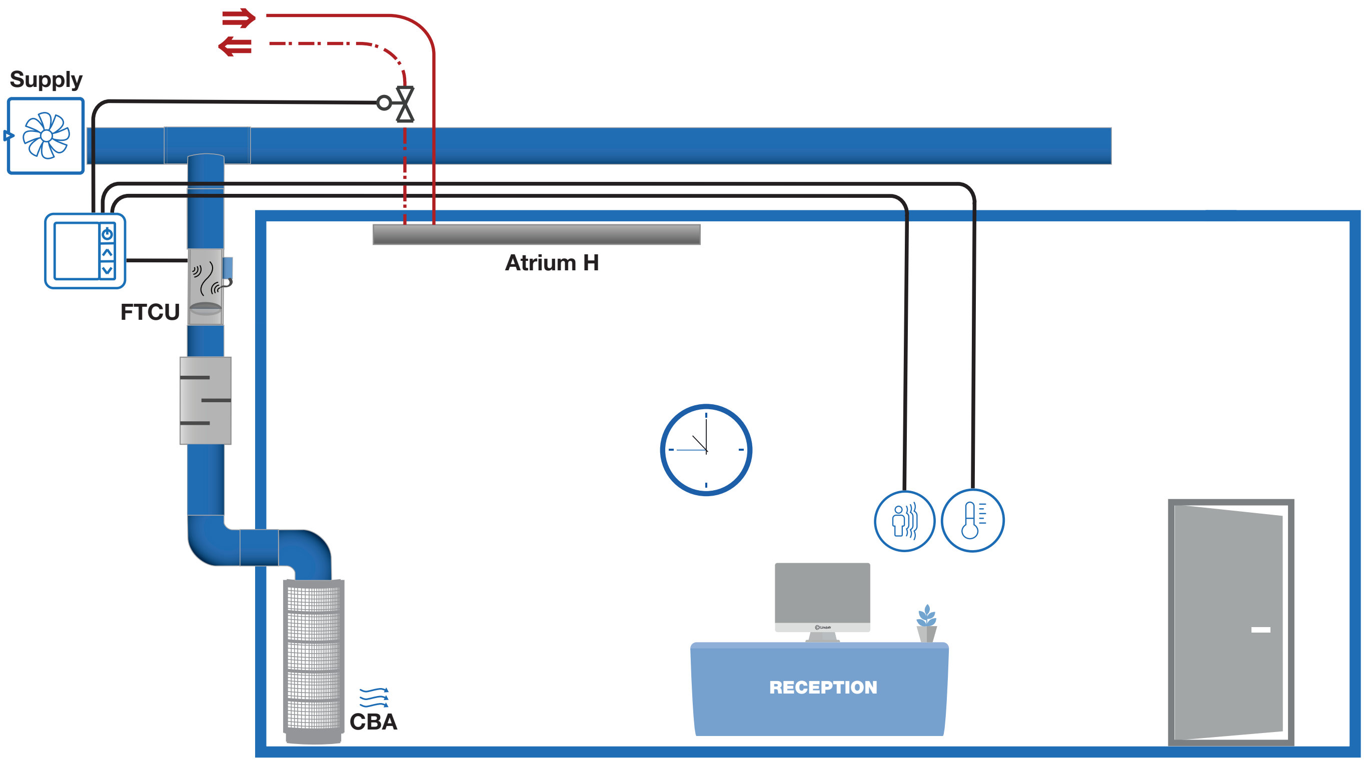
Solution 6B

Displacement ventilation.
Room controller with temperature regulation, external sensors. Controlling airflow with FTCU to displacement diffuser.



Solution 6C

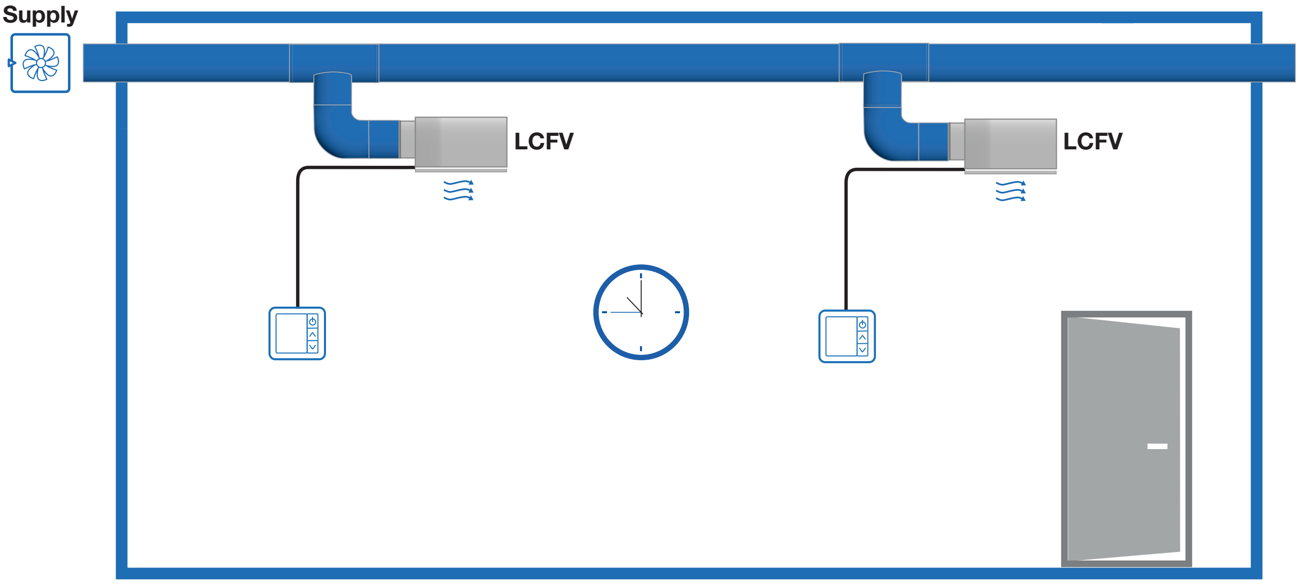
Displacement ventilation.
Room controller with temperature regulation, external sensors. Controlling airflow with FTCU to displacement diffuser.
Heating from radiant panel (Atrium H).



VAV & DCV Solutions

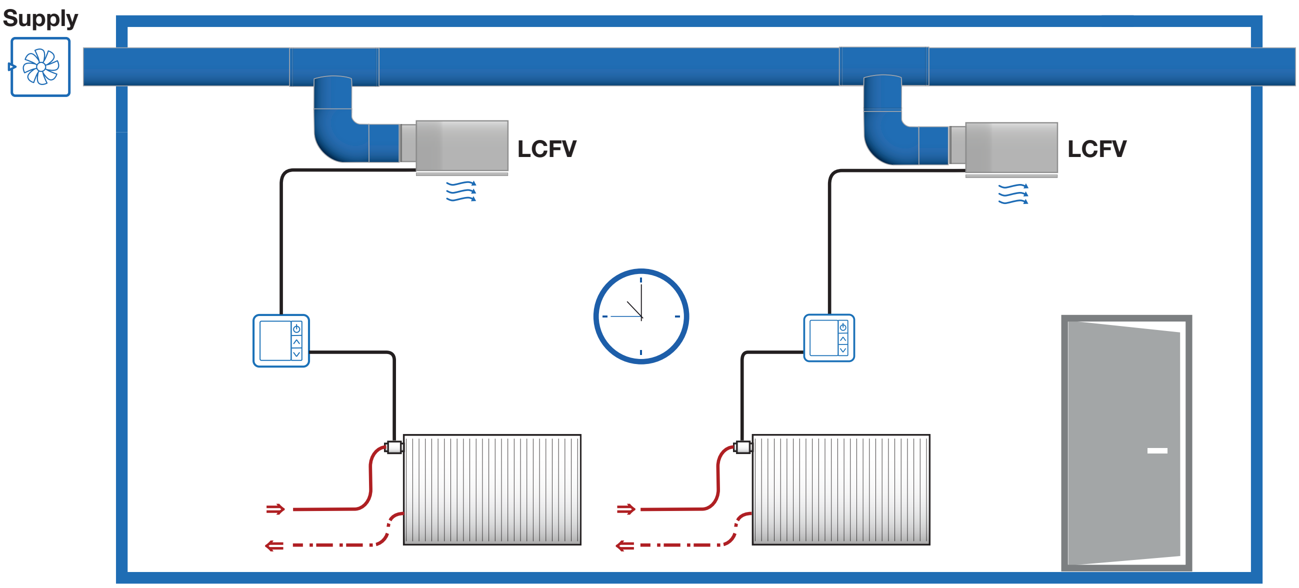
Solution 6D

Mixed ventilation
Room controller with temperature regulation. Controlling airflow with visible diffusers LCFV.



Solution 6E

Mixed ventilation
Room controller with temperature regulation. Controlling airflow with visible diffusers LCFV, and separat radiant heating.



VAV & DCV Solutions

Extract solutions

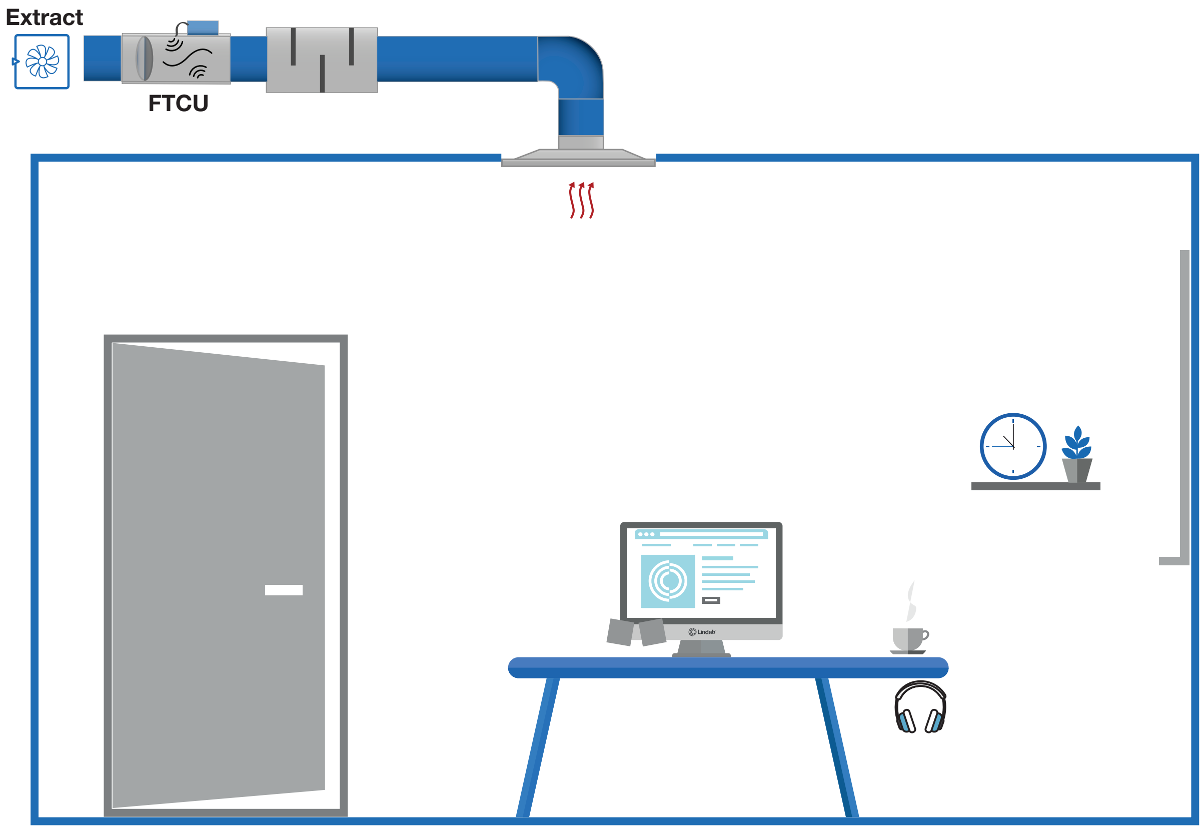
When creating a VAV/DCV ventilation system, there must be both supply and extract. The chapter describes the most common extract solutions.
It is important that the airflows for supply and extract are in balance. If there is a difference there will be over/under pressure in the building. In a tight building, this can result in doors that can not open. Noise from windows. Extra energy consumption from fans and heating system.
Lindab recommends that buildings are divided in sections. The division can be made on floorlevel. Each section will be kept in balance to avoid issues and to keep a better overview of the building in sections.

The solutions in this chapter can be combined in most ways with one off the supply solutions. Of cause, it is not possible to combine two duct-less solutions.

Contact you local Lindab office for further information or different solution questions.

Solution E1

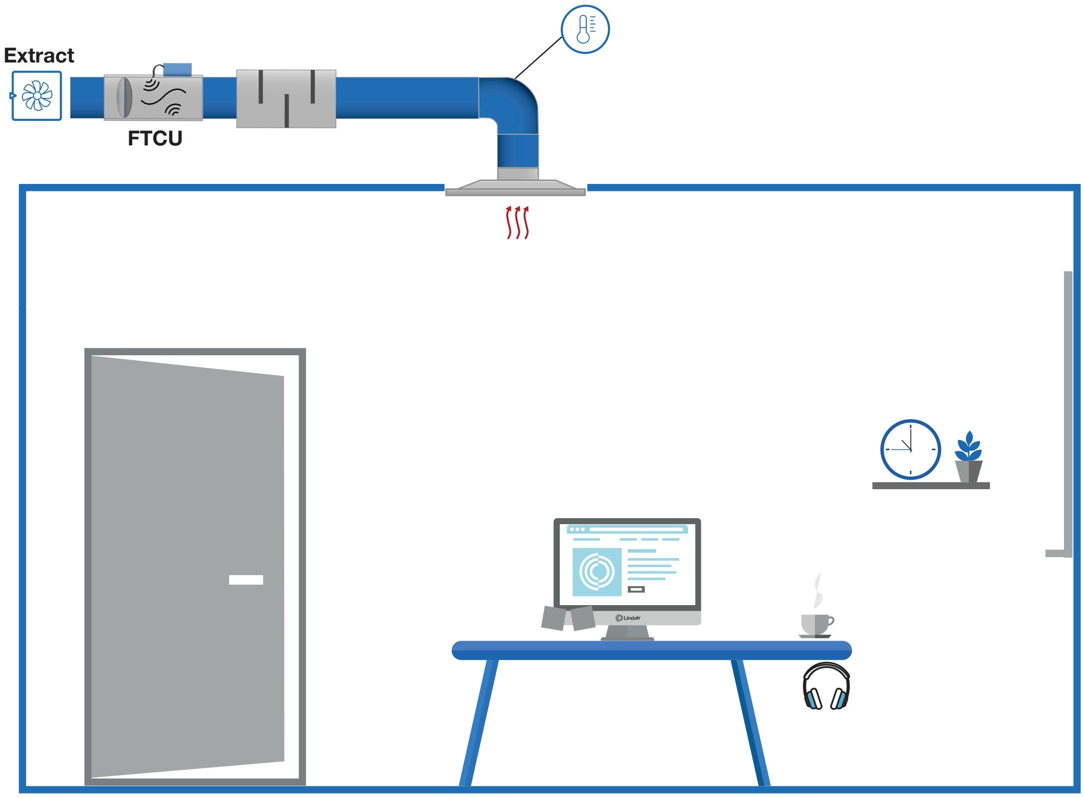
Balanced extract with FTCU in small temperature zone.



VAV & DCV Solutions

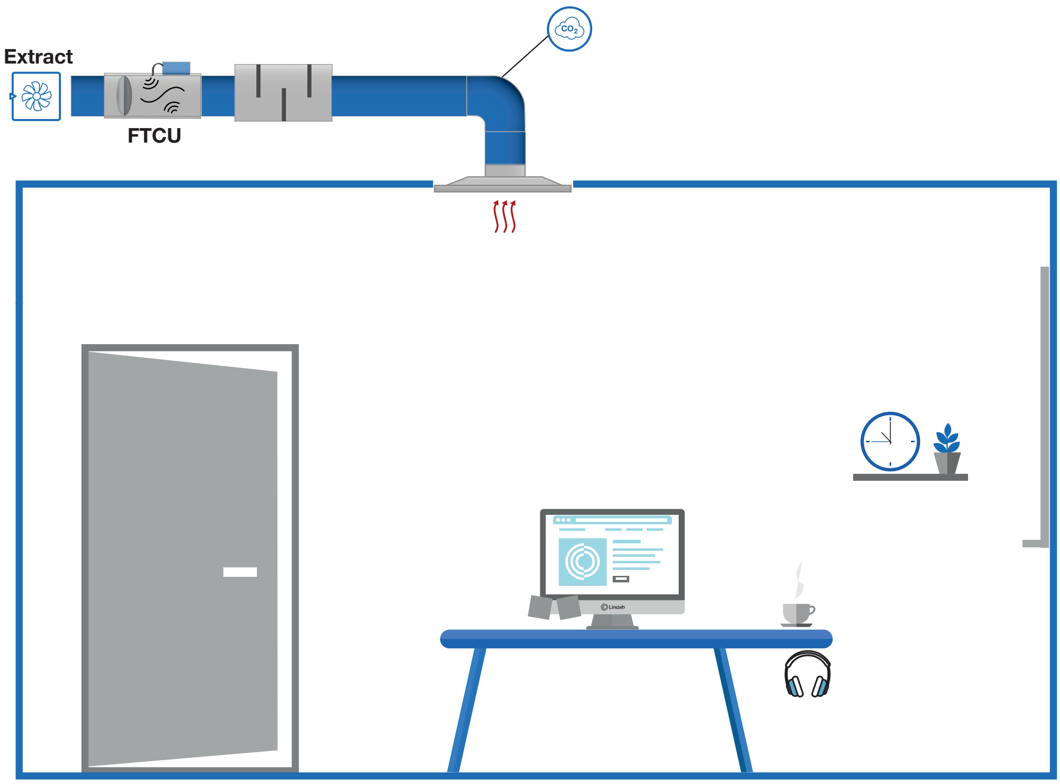
Solution E2

Balanced extract with FTCU and temperature duct sensor in small temperature zone.
Room temperature is measured in duct, to be used in room regulation.



Solution E3

Balanced extract with FTCU and CO_2 duct sensor in small temperature zone.
CO_2 is measured in duct, to be used in room regulation.



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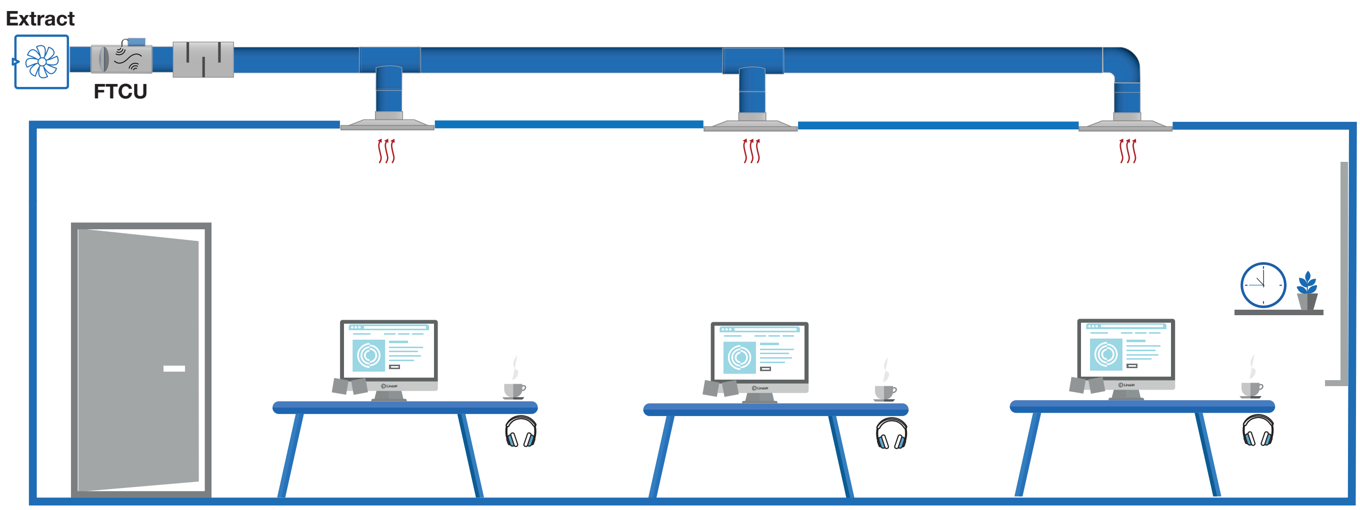
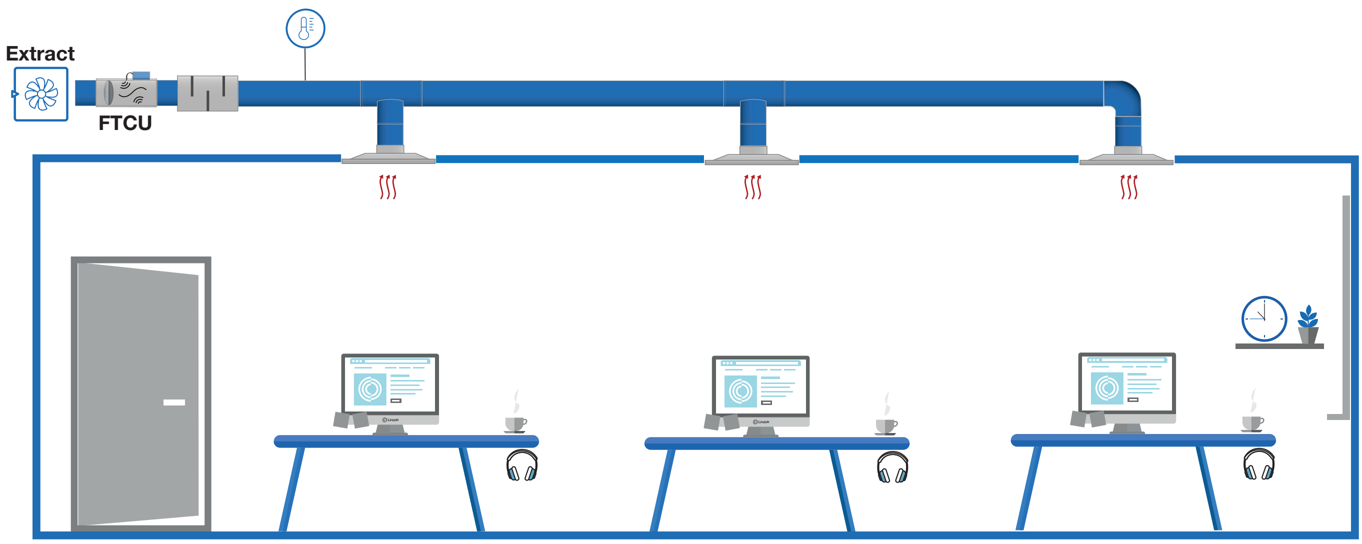
Solution E4

Balanced extract with FTCU in large temperature zone.



Solution E5

Balanced extract with FTCU and temperature duct sensor in large temperature zone.
Room temperature is measured in duct, to be used in room regulation.



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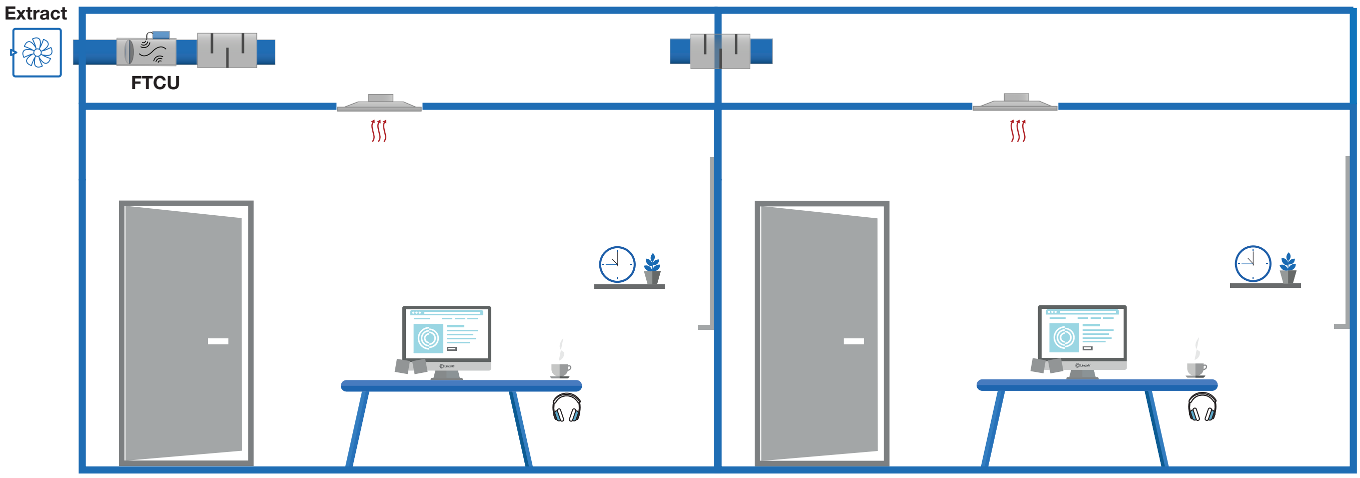
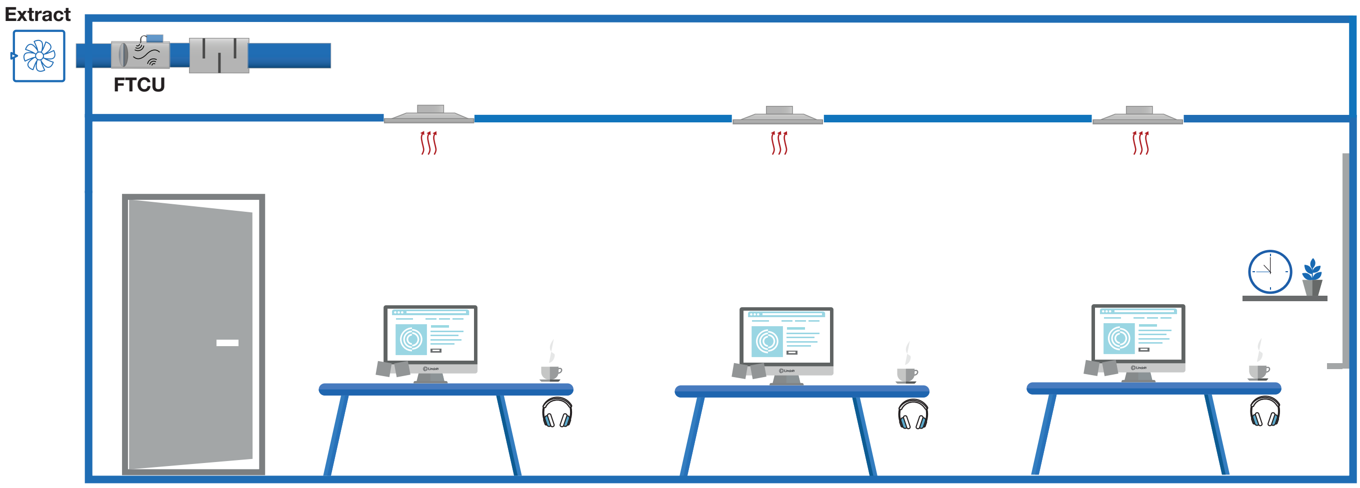
Solution E6

Balanced extract with overflow between rooms. For several small temperature zones.
Air movement between rooms above suspended ceilling though silencers.



Solution E7

Balanced extract with FTCU in duct-less system for Large temperature zone.



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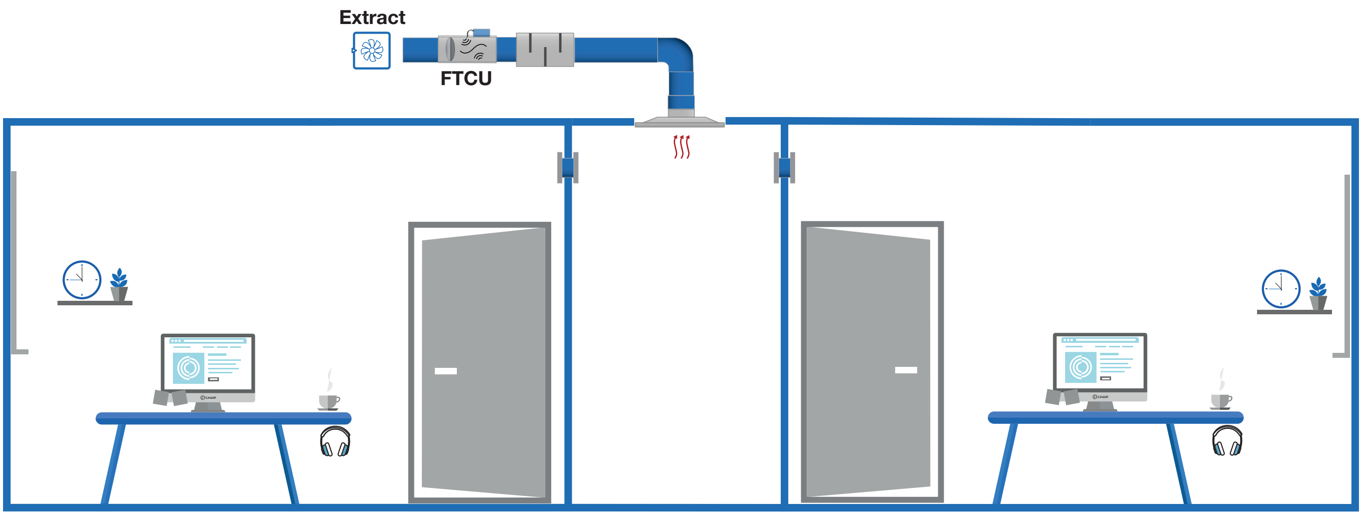
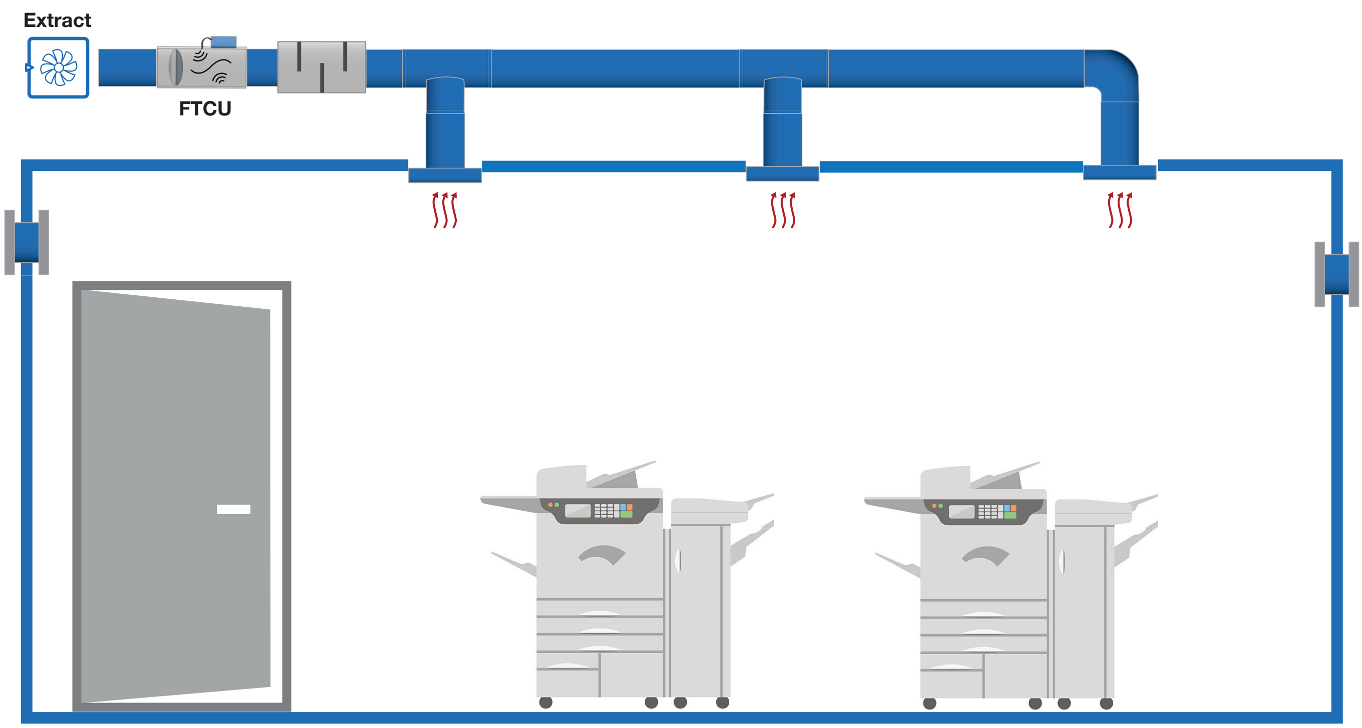
Solution E8

Balanced extract from hallway and pressure control valves from temperature zones.



Solution E9

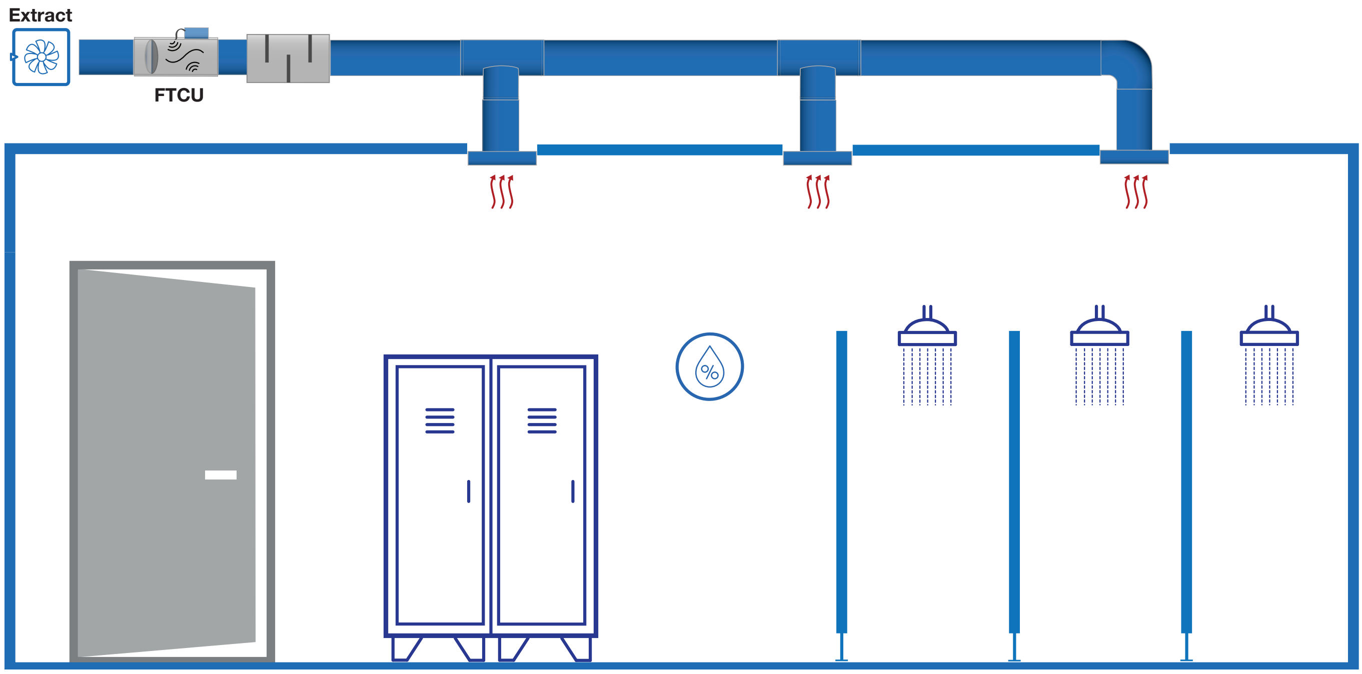
Constant extract regulated with FTCU. Pressure control valves to balance.



VAV & DCV Solutions

Solution E10

Balanced extract regulated airflow with FTCU and humidity sensor in zone.



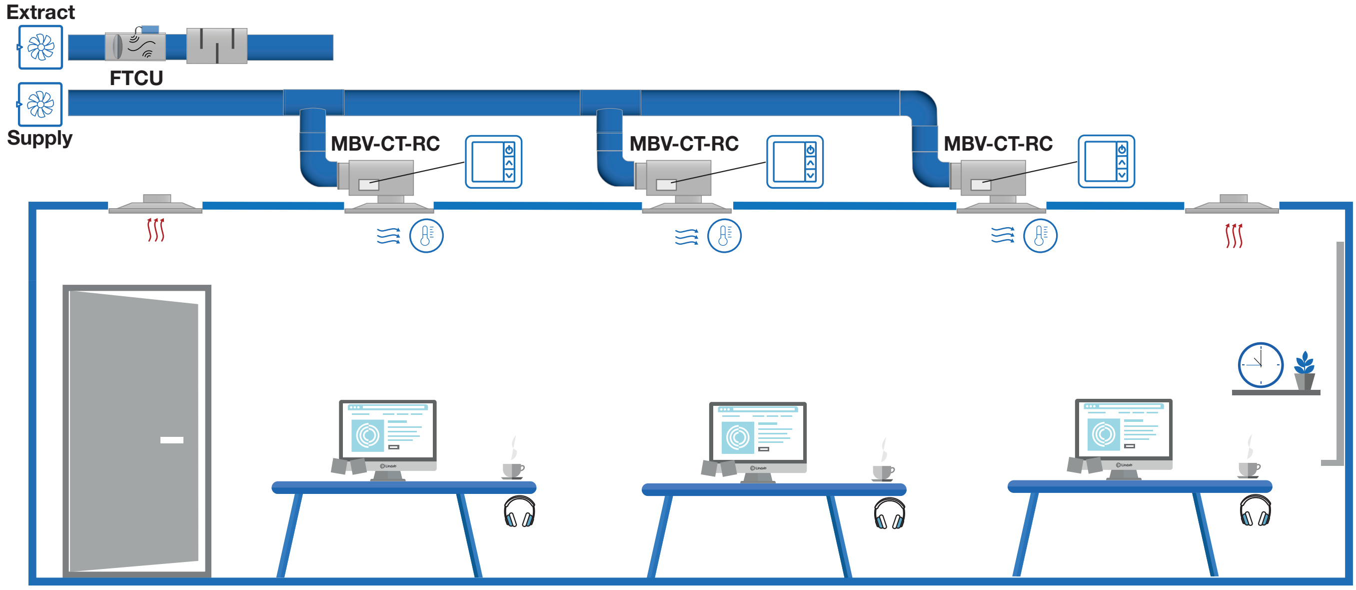
VAV & DCV Solutions

Complete Solutions

This chapter shows complete solutions with both supply and extract combined with each other.
The solution can be combined in several ways here is only showed the most used complete solution if you do not find the system that you will design, it is very possible that it can be designed. You can always contact your local Lindab office for further information and help to design a complete building solution with VAV/DCV.

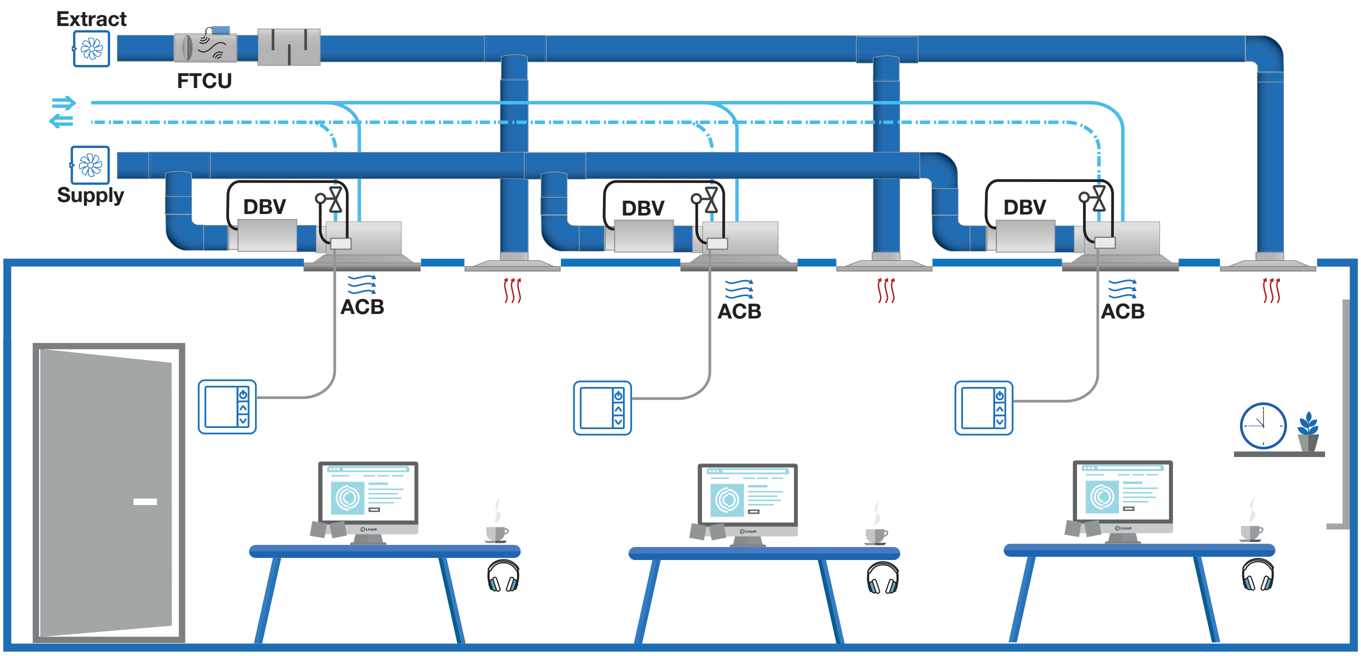
Solution C1

Room controller mounted on MBV with temperature regulation. Sensor integrated in ceilling diffusers, individual temperature zones.
Balanced extract with FTCU in duct-less system.



Solution C2

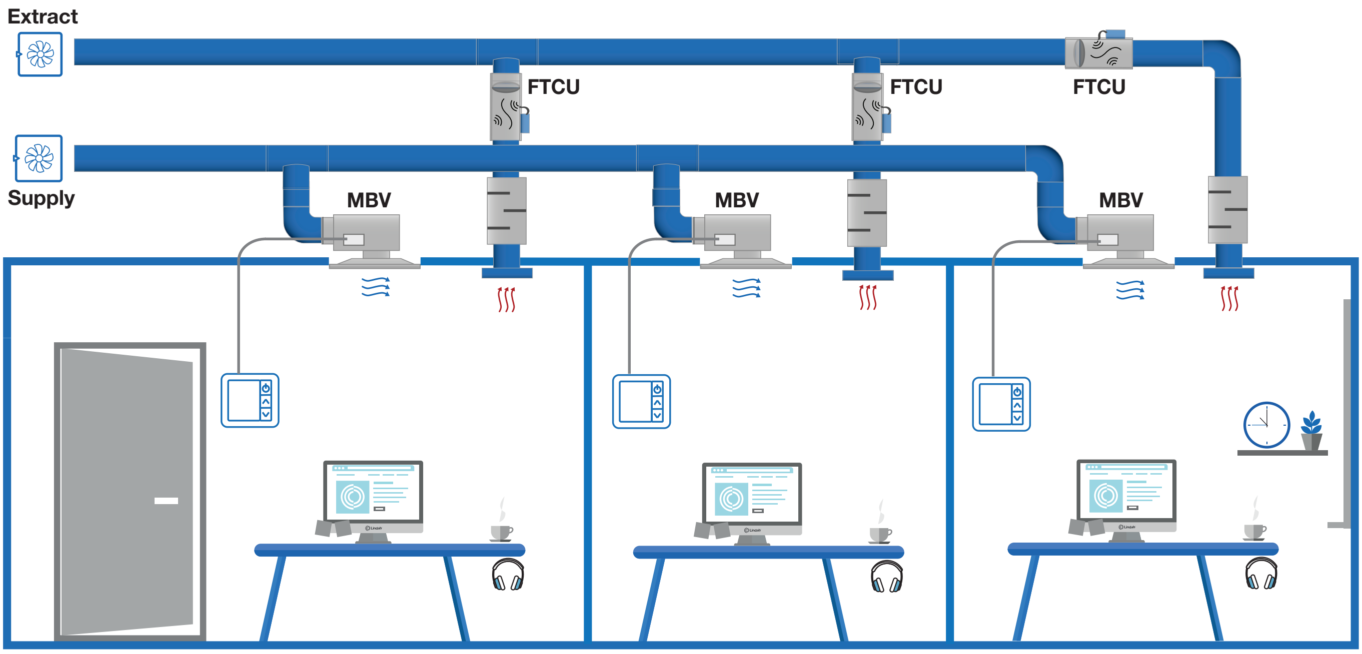
Room controllers with temperature regulation. Controlling air- and waterflows with active chilled beams and DBVs to induvidual temperature zones.
Balanced extract with FTCU for each temperature zone.



VAV & DCV Solutions

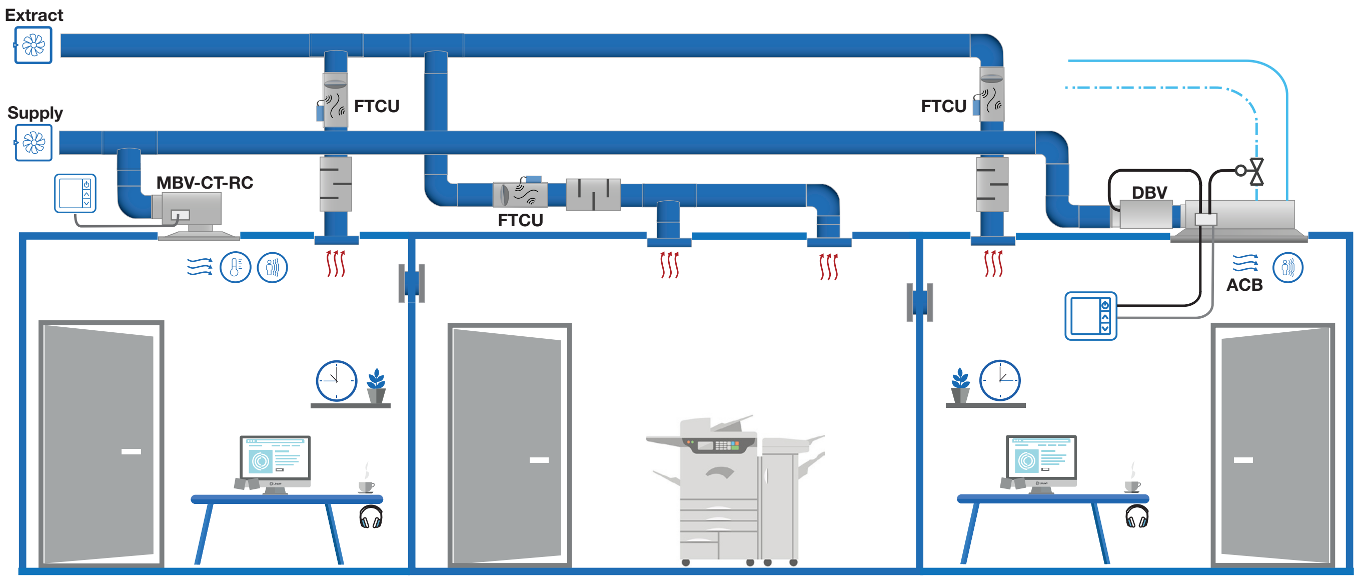
Solution C3

Room controller with temperature regulation, controlling airflow to room with MBV.
Balanced extract in each room with FTCU.



Solution C4

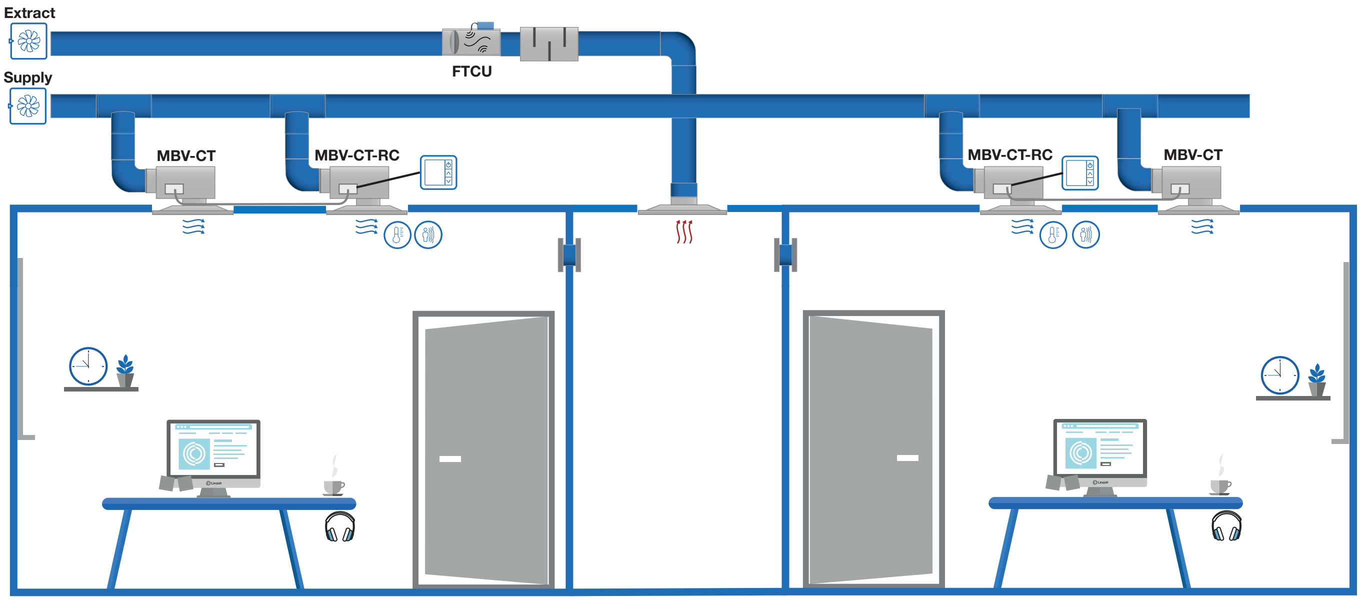
Single offices with different heat load.
ACB solution with room controller for temperaure regulation. Presence sensor integrated in ACB.
MBV solution with presence and temperature sensor intregreted in ceiling diffuser.
Constant extract with FTCU in "printer room?" balanced with overflow from offices. Variable extract in the offices to compensate the total supply airflow to balance section.



VAV & DCV Solutions

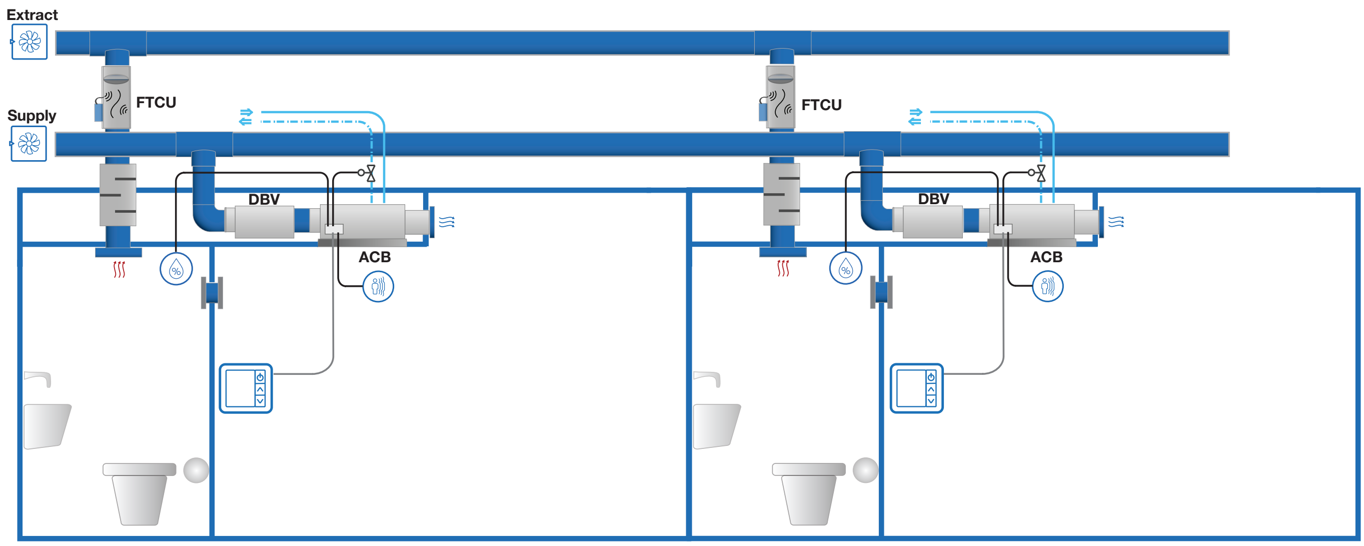
Solution C5

Room controllers mounted on MBV with integrated sensor in ceiling diffuser. Controlling airflow to large temperature zone with parallel connected MBVs.
Central extract from hallway with overflow to each office. Airflow regulated with FTCU.



Solution C6

Hotel room solution, with supply and extract balanced in each room over bathroom.
Airflow regulation with temperature, presence and humidity.
ACB for individual temperature in each room.



Most of us spend the majority of our time indoors. Indoor climate is crucial to how we feel, how productive we are and if we stay healthy.

We at Lindab have therefore made it our most important objective to contribute to an indoor climate that improves people's lives. We do this by developing energy-efficient ventilation solutions and durable building products. We also aim to contribute to a better climate for our planet by working in a way that is sustainable for both people and the environment.

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