System technology

Demand controlled ventilation – WISE

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Content

Room products

DCV

All the air terminals included in Swegon's WISE system are variable-flow air diffusers. They maintain exactly the right airflow with regard to occupancy and temperature which ensures that you always have precisely so much air in the room that is necessary. When the room is unoccupied, or the demand for supply air is low, energy is saved. Variable airflows are a necessary condition in applications that call for the use of supply air to provide comfort cooling.

A more pleasing indoor climate can be obtained, especially in Northern Europe, if variable flows are used in applications that do ***not*** have comfort cooling – an alternative that is seldom utilized. Opportunity to reduce the supply air flow makes it possible to utilize free cooling whenever the outdoor temperature is lower than the room temperature. This occurs involuntarily and leads to poor thermal comfort in the room, particularly during autumn and spring, when supply air below room air temperature is used in combination with a CAV system.

Pressure independent

WISE is a pressure-independent system. The air terminals adjust themselves to the correct flow independent of available pressure in the duct upstream of the air diffuser. This enables the WISE system to operate perfectly, even while the building is being renovated or retrofitted, when it is desirable to keep the existing duct system. The air handling unit and the zones must be pressure controlled.

Sensor module

All the air terminals are equipped with an integrated sensor module that contains sensors for the absolutely most common control parameters.

Among them we find the **presence detector**, which minimizes the airflow and increases the dead zone for temperature control when no occupant is in the room. When a person enters the room, the setpoints revert to the normal setting, and the minimum flow increases to meet the current demand. **The temperature sensor** senses the room temperature and transmits a reading that prompts the controller to increase/decrease the airflow as required. An **in-service indicator** informs the user with a pleasing, hardly noticeable green glow that the air terminal is operating as it should. The green LED changes to red, if something should go wrong with the controller, pressure sensor or similar component.The in-service indicator can also be used for informing the user that the desired degree of comfort in the room is being maintained, with regard to temperature and air quality (if an air quality sensor is used).

Via the sensor module you can also adjust setpoints, change settings, and can read actual values using the TUNE Adapt **hand-held unit. The outlet** for TUNE Adapt is on the inside of the simple-to-dismantle sensor module. See Figure 3.

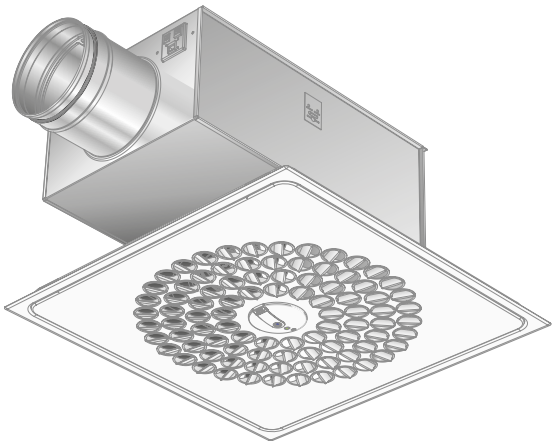


Figure 1. ADAPT Colibri.

Figure 2. The sensor module.

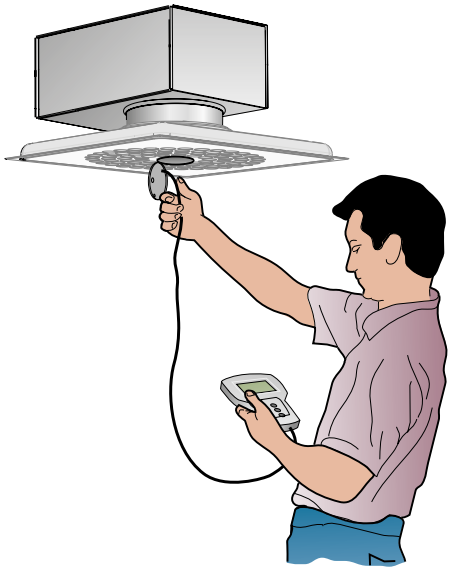


Figure 3. To connect the hand-held unit

Junction box

A CONNECT Adapt junction box, Figure 3, is included with each air diffuser (master) for simple installation and wiring. As a suggestion, the junction box is mounted on the wall. The box contains the necessary terminals for wiring a 24 V power supply. The air diffuser is very simple to wire using the LINK Adapt RJ45 cable (Internet cable) supplied. You simply "click" the cable into the air diffuser and the junction boxes respectively, see Figure 4. Since the air diffuser is pressure dependant and is supplied preset from the factory with min. and max. flow settings as well as other setpoint settings, the air diffuser is commissioned and in operation after it is installed.

The air diffuser has provision for connection to a main control system (ModBus RTU). Then you connect a second cable, LINK Modbus (RJ12 telephone cable) between the air diffuser and the junction box and the air diffuser is then ready for communication via the main control system. The controls contractor wires the cables to terminals in the junction box. Particulars of the necessary addressing are available in the Project Manual supplied for each project (supplied together with the TUNE Adapt), but can also be downloaded from www.swegon.com.

Besides these connection options, the product has the following:

- Output for slave control of the extract air (RJ45 that simplifies connection of the WISE product).
- 0-10 V DC output for slave control of the extract air (terminal for wiring another product: 12, 13).
- 24 V AC pwm output for control of the radiators in sequence if two-stage cooling has not been selected.
- Two-phase cooling with water in the second stage (deactivates heating in sequence).
- 24 V output for utilizing a presence detector (for e.g. the control of light fittings).
- Input for TUNE Temp. manual setpoint selector switch or DETECT Quality CO_2sensor).
- Inlet for external presence sensor DETECT Occupancy.

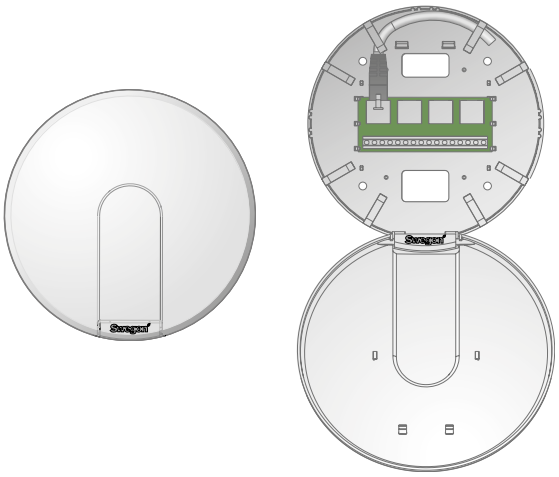


Figure 4. CONNECT Adapt junction box, closed and open.

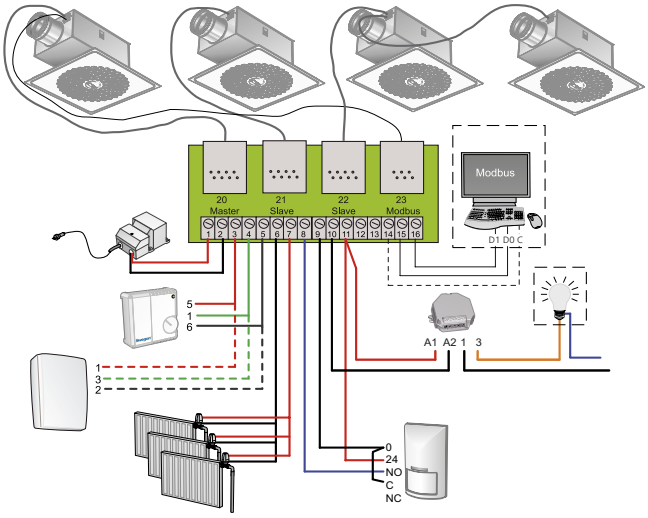


Figure 5. ADAPT air diffusers, wiring diagram

Larger rooms and premises

Active dampers instead of active air diffusers and registers are recommended for larger airflows. This involves fewer moving parts and provides a more cost-effective solution. Swegon has room dampers specially developed for demand-controlled ventilation, with provision for regulating down to extremely low airflows with excellent measurement accuracy. Since the dampers are duct products, they lack a sensor module with integrated temperature sensor and presence detector.

Room damper

Swegon has two types of room damper, the ADAPT Damper and CONTROL Damper. These dampers differ in terms of which parameters you want to check in the room, which airflows are required in the room and whether you want to control the heating and/or two-step cooling in sequence. For detailed information, we refer to the relevant product data sheet.

Clean Air Control

The Clean Air Control function is used for regulating the airflow to maintain the air quality based on the content of VOC (volatile organic compounds) and other gases that are emitted in the room from furniture, people, etc. The CAC sensor does not measure CO_2, however it is configured in order to also correlate with CO_2. This means that it reacts in the same way as a conventional CO_2 sensor with regard to the presence of occupants in a room, but beyond that it also reacts to substances, to which a CO_2 sensor does not react.

Figure 6. ADAPT Damper

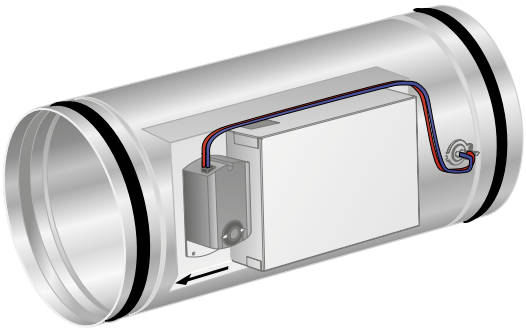


Figure 7. CONTROL Damper.

Accessories – ADAPT room products

DETECT Quality
Carbon dioxide sensor for wall mounting which should be wired to the junction box if the airflow in the room is also to be controlled on the basis of air quality. The sensor is preset and calibrated from the factory. The preset limit value is 1000 ppm.

Figure 8. DETECT Quality.

DETECT Occupancy
DETECT Occupancy is an IR type presence detector for use in combination with ADAPT Damper for readjusting between presence and absence of occupants. Adjustable on/off switching delay. Available for wall or ceiling mounting. A mounting bracket that enables angular adjustment of the sensor for optimal coverage of the room is included for the wall-mounted variant.

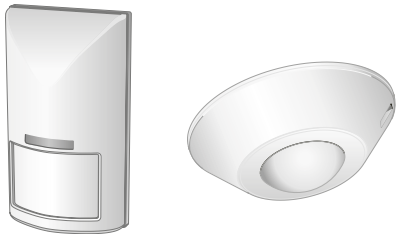


Figure 9. DETECT Occupancy, wall- resp. ceiling mounted.

TUNE Temp
Setpoint selector switch that enables the occupant to increase/decrease the room temperature on an individual basis. TUNE Temp is usually mounted on an inner wall to the side of the door and should also be wired to the junction box.

DETECT Temp
External temperature sensor for use when the ADAPT Damper is used in combination with transfer air and central extract air. The master damper is then located in the supply air duct and requires an external temperature reference.

Figure 10. TUNE Adapt

TUNE Adapt
Hand-held micro terminal for the control of actual values and the setting of setpoints (all the air diffusers are pre-adjusted from the factory). A hand-held micro terminal is needed for reading the actual values and/or possibly changing the setpoints. Swegon recommends that each ventilation system include at least one hand-held micro terminal.

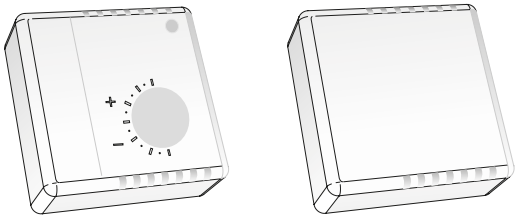


Figure 11. TUNE Temp, DETECT Temp.

LINK Modbus
LINK Modbus is required in applications in which it is desirable to communicate down to room level from a main control system. LINK Modbus is a quick cable for simple installation. Swegon's FIX Link cable kit is recommended for simple fastening of the cabling. LINK Modbus is used for communicating with the master air diffuser. If it is also desirable to communicate with the slave air diffusers, they must also be connected up to the Modbus loop. This is done by supplementing the slave air diffuser with a CONNECT Adapt and a LINK Modbus or with SPLIT Link between the slaves.

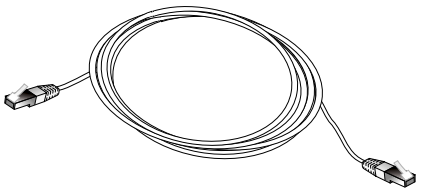


Figure 12. LINK Adapt.

LINK Tuneadapt
The RJ12 modular cable for extending the outlet for TUNE Adapt, permits contact from room level with the ADAPT Damper installed high above the false ceiling.

LINK Adapt
RJ45 modular cable for wiring between master diffuser/damper and CONNECT Adapt if lengths other than those which included in the supply are needed.

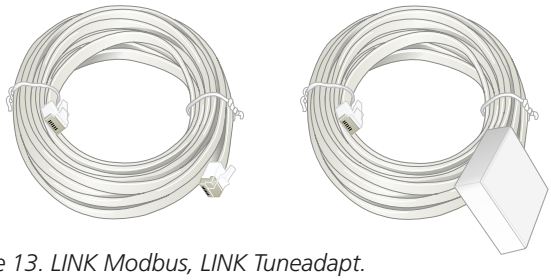


Figure 13. LINK Modbus, LINK Tuneadapt.

SPLIT Link
A branch connector for the connection of slaves is available for both LINK Adapt (RJ45) and LINK Modbus (RJ12).

FIX Link
FIX Link for securing cables to ducts, for example. The holder is fastened to the duct by means of self-tapping screws/pop rivets; the bundling band is inserted through and locks the cables in place. Self-tapping screws or pop rivets are not included in the supply.

POWER Adapt
Single phase protective transformer for main plug connection, unearthed or earthed. The transformer is made of impact-resistant, light grey, self-extinguishing thermoplastic. POWER Adapt manages to operate a normal office room with 2 pc ADAPT dampers and up to three radiator valves. Meets applicable requirements for electrical safety/ emissions and immunity.

ACTUATOR
All the WISE air diffusers can control up to three radiator actuators in sequence in order to prevent the radiators from heating while air is used to cool down the room. Swegon can also supply the actuator complete with valve and suitable adapter.

VALVE
Radiator valve of angled or straight design. Dull nickel-plated bronze.

ADAPT Relay
Relay for on/off control of the lighting, designed for installation in a wall terminal box or the like. As an alternative, the relay can be supplied with a type CONNECT Adapt round enclosure conforming to degree of protection IP30.

FSRb
Clamp made of galvanised sheet steel, used for facilitating installation and removal of damper units. The clamp has adjustable eccentric locking devices for simple and quick locking/opening. The rubber gasket allows sealing directly against duct nipple. Always fit the clamp on the "room side" of the damper.

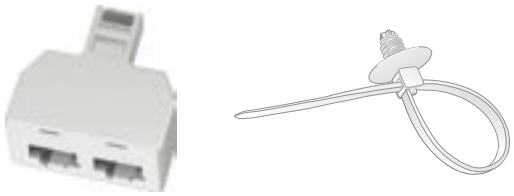


Figure 14. SPLIT Link. FIX Link.

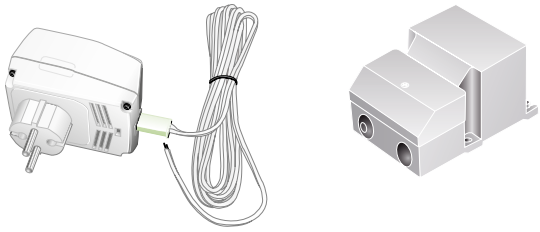


Figure 15. POWER Adapt 20 VA and 60/150 VA.

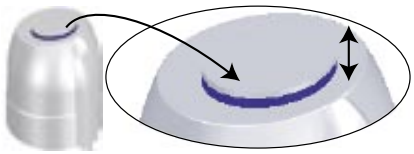


Figure 16. ACTUATOR, damper blade position indicator.

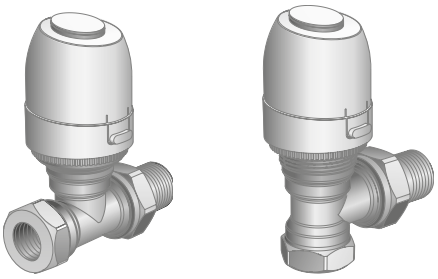


Figure 17. Valve VALVE-S (straight) and VALVE-A (angled) with ACTUATOR valve actuator mounted.

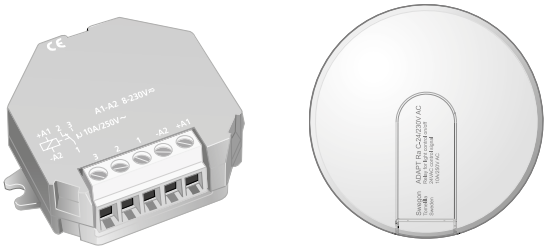


Figure 18. ADAPT Relay in non-enclosed version (N) and enclosed (C).

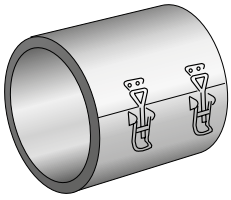


Figure 19. FSR, clamp.

Sizing

Selection of flow:

When selecting air diffusers or dampers always base your selection on the design airflow. The selection is determined either by the number of persons who will occupy the room or the heating loads that must be dealt with. The flow requirements that apply vary from country to country, however we can generally say that one ought to size the airflow on the basis of 10 l/s and person.

Heating loads:

The heating loads that must be dealt with are the following:
Approx. 100 W/person, lighting approx. 10 W/m^2, possible computer (150 W/computer) and heat generated by other electronic equipment.

These values differ very little from case to case, however another important heat source to keep in mind is solar radiation. Depending on the size of the window pane, window quality, point of the compass and whether the building has sun shield, the result can vary drastically. Therefore a climate calculation for a number of representative rooms is recommended.

Sound/throw:

Select air diffusers or dampers that can manage the maximum airflow. Check possible demands on low noise level, maximum permissible pressure drop across the air diffuser and the throw. Consideration must be given to the addition of sound sources if both supply air diffusers and extract air registers are to be installed in the room (balance). Use the quick-selection tables on the first page of the product data sheet, or the sizing diagrams.

Central extract air or balance in the room?

An installation with only one or more supply air diffusers and a door or wall grille for the transfer of air out to the corridor is the most economical solution and is recommendable in most cases. If the rooms are larger and the airflows increase, or if there are demands on minimum acoustic disturbance, (for example in conference rooms), take steps to achieve correct airflow balance. In the following, a few different room solutions with the products involved are presented.

Example 1

10 m^2 individual-room office, climatic requirement: 23 °C, supply air temperature: 15 °C

Number of persons	1	100 W
Lighting		100 W
Computer	1	150 W
Sunshine		100 W
		450 W

ΔT = 8 K provides 450 / (1.2 x 8) ≈ 45 l/s

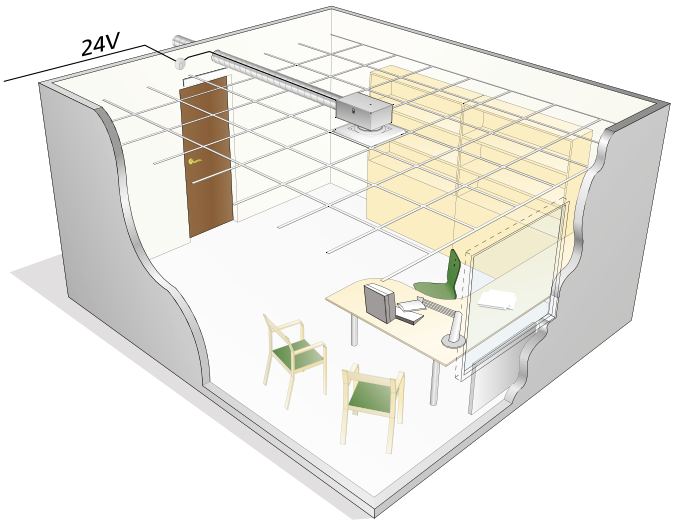
Size the system for a max. permissible airflow of 45 l/s. As a suggestion, set the minimum airflow for occupancy to 12 l/s and the vacancy airflow to 5 l/s.

Functionality in the standard version

Swegon's ADAPT air terminal series ventilates and cools air on the basis of temperature and occupancy. The temperature requirement for occupancy is
22 °C ±1°. When there are no occupants in the room it is possible to accept greater deviations from the 22 °C +3, -2° climate required. 20 °C is then acceptable in the winter and 25 °C in the summer. In this way we can save energy. Additional energy can be saved if we arrange for the presence detector signal to also control the lighting in the room.

This functionality is in many cases sufficient; however it is also possible to obtain these functions with accessories:

- To make the air diffusers ready for Modbus communication with a main control system
- To control the room on the basis of its CO_2reading
- Two-stage cooling (de-activates heating in sequence)
- To control the radiator valves in sequence
- To slave control other supply air diffusers and extract air registers
- To enable the user to vary the temperature in the room (setpoint selector switch)

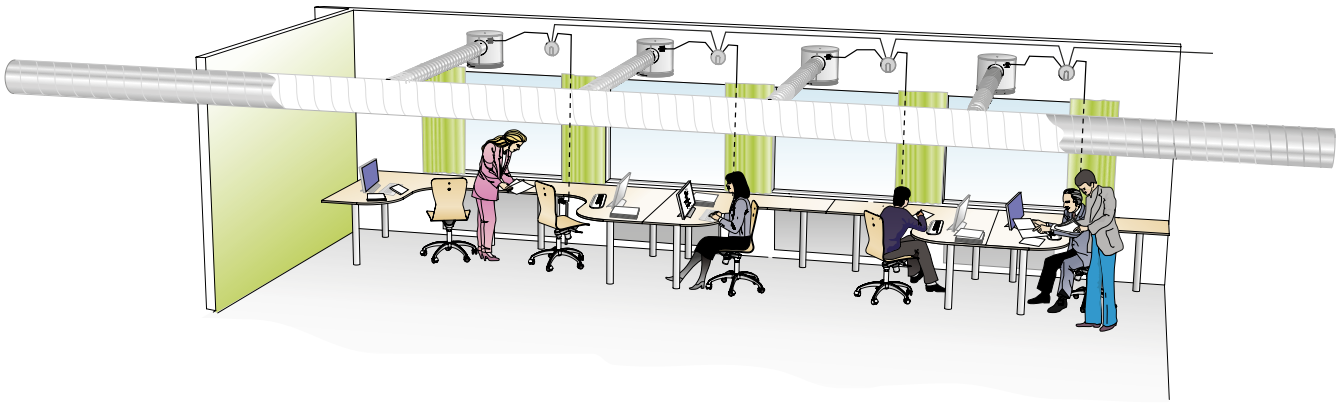


Example 2

Open-plan office

Open-plan office today, individual-room office tomorrow. Flexibility, to be able to offer changes based on the requests of the client without the costs soaring, is important for the owner of the building. It is therefore advisable to design "imaginary" walls already from the start and select a supply air diffuser per window module.

One alternative is to let one air diffuser be a master for a number of slave air diffusers. The Swegon recommendation is that you already from the start install every air diffuser as a master air diffuser. This way the air diffusers operate completely individually and possible accessories such as Modbus communication and radiator control will be connected to the correct air diffuser.



Example 3

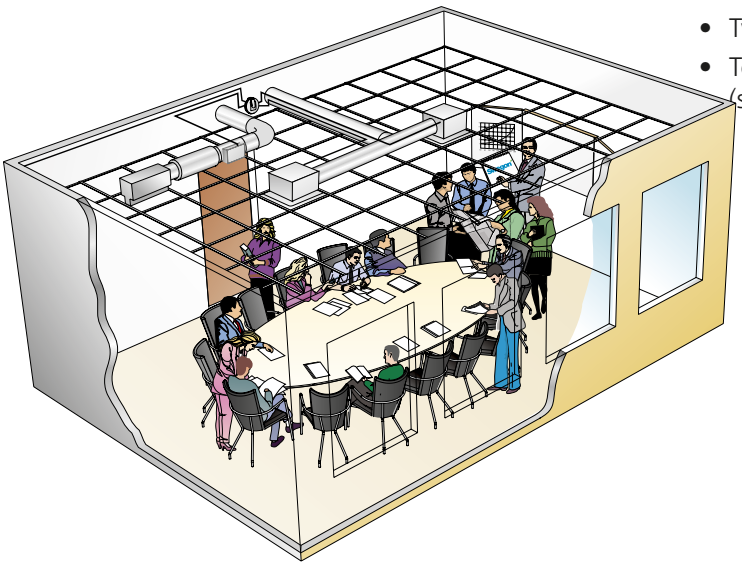
25 m²conference room, climatic requirement 23 °C, supply air temperature 15 °C

Number of persons	15	1500 W
Lighting		200 W
Presentation equipment		300 W
Solar radiation		300 W
		2300 W

Δt = 8 K provides 2300 / (1.2 x 8) ≈ 230 l/s

Size the room based on a max. permissible airflow of 250 l/s.

As a suggestion, set the minimum airflow for occupancy to 50 l/s and the vacancy airflow to 25 l/s. Supply air and extract air in balance is recommended in this case, to be sure to prevent acoustic disturbance problems.



Functionality in the standard version

Swegon's ADAPT Damper with CAC functionality ventilates and cools in response to the existing room temperature and air quality. The damper contains an integrated temperature sensor and an integrated air quality sensor. The master damper should be fitted on the extract air side and slave control the supply airflow.

In order to be able to make use of the airflow in an unoccupied room, this solution is supplemented with an externally mounted presence detector, which also provides opportunity for other room set points while the room is unoccupied. This offers the building owner even greater energy savings.

It is also possible to do the following:

- To get the air diffusers ready for Modbus communication with a main control system
- To control the radiator valves in sequence
- Two-phase cooling (de-activates heating in sequence)
- To enable the user to vary the temperature in the room (setpoint selector switch)

Zone products

Why zone dampers?

In a demand-controlled ventilation system, the flow is controlled, based on the needs of the room. The other parts of the system are pressure controlled. When the airflow in a room changes, the fan must compensate for this change. In a larger system, the air handling unit does not sense such a small change. The result is that the air diffusers in the adjacent rooms begin to adapt, in order to keep their flows, which in turn leads to too many unnecessary motor movements. In order to prevent this, the system is split up into smaller sections, zones, which control to their respective reference pressures. This enables quicker reaction to pressure changes and by that means a more stable system with an optimised number of motor movements.

What is a zone?

A typical example of a zone is a storey or a section of a storey. In the same way as the air handling unit controls the pressure and flow balance for the whole system, the zone dampers control the pressure and flow balance within a section of the system, a zone.

How does the zone damper work?

The CONTROL Damper is utilised as a zone damper (which can also be used as a room damper). The main function of the zone damper is to maintain constant pressure in each branch duct. At the same time, the damper measures the flow and can therefore also slave control other dampers. The zone damper can in certain cases also be used as a constant flow damper. Communication between dampers and the main control system takes place via Modbus RTU. In order to add and subtract several flows within a zone, the system is supplemented with the CONTROL Optimize system optimizer. Some examples of commonly occurring zone solutions will follow over the next few pages.

CONTROL Damper functions:

- Maintaining constant pressure in the zone
- Flow measurement
- Slave control of the extract air flow
- Modbus communication
- Adding and subtracting of airflows (in combination with CONTROL Optimize)

CONTROL Damper accessories

DETECT Pressure
Measurement of static pressure

SLAVE Control
Slave control of extract airflow with provision for offset value.

CONTROL Optimise
Summation of airflows from several zone dampers (CONTROL Damper)

TUNE Control
Hand-held micro terminal for the setting of setpoints and for reading actual values.

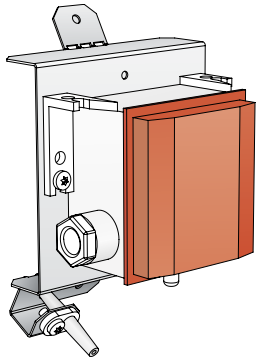


Figure 20. DETECT Pressure.

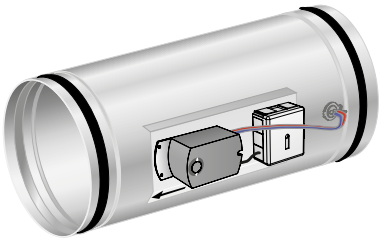


Figure 21. SLAVE Control.

Figure 22. CONTROL Optimize.

Figure 23. TUNE Control.

Sizing

New construction

Sizing of the duct system

We recommend for new construction projects that you do the sizing according to max. pressure drop 1 Pa/metre for the branch duct (zone) and main duct (shaft). The sizing of room products is done exactly as it is for conventional air diffusers; using the relevant quick selection table or sizing diagram (a rule of thumb is that the air velocity upstream of the air diffuser should never exceed 3 m/s).

The result will be a well-performing ventilation system without risk of either high pressures or sound levels.

This applies to branch ducts that are max. 40 metres long. If the branch ducts are longer, you can advantageously divide 40 by the relevant duct length, in order to have maximally sized pressure drops/m for that zone. However, Swegon always recommends that you carry out a pressure drop calculation.

Location of the pressure sensor

The pressure sensor should always be positioned 2/3 of the distance out in the branch duct. This pertains to both supply air and extract air ducts. In order to have authority in the system, the recommended setpoint for the pressure sensor is at least 40 Pa for supply air, and 50 Pa for extract air.

Selection of damper size

Sometimes the flow range of a damper of specific size is not in agreement with the size of the branch duct, when it comes to the total min. flow for all the rooms in the zone. This should always be checked. In cases when the min. flow for a specific damper size is higher than the total min. flow for all the rooms in the zone, we recommend selecting a damper in a smaller size and downsizing or up sizing again other components upstream and downstream of the damper.

Renovation, rebuilding, extension

The existing duct system should be utilized to the greatest possible extent in renovation, rebuilding and extension projects, as a means of limiting the costs. If the system follows the criteria that apply to new construction, then these of course apply to sizing. The alternative is higher velocities in the branch duct, which causes higher dynamic pressure and probably higher total pressure across the air diffusers. One positive consequence is that the one-time resistance near the branch tube increases if the velocity is higher in the branch duct and in such a way “eats” up a portion of the pressure that the air diffuser should take. Since there is no existing standard that defines how a renovation, rebuilding and extension ventilation system should look, it is difficult to provide any limit values. Nevertheless, Swegon has prepared a quick selection guide for air diffusers that applies to an 80 Pa pressure drop across the air diffusers (P_s 60 – 80 Pa in a branch duct). If 35 dB (A) is acceptable in the room, this will work excellently. A pressure drop calculation is of course also recommended here. If you are uncertain, send a pressure drop calculation for the zone in or item in question to the nearest Swegon office and we will help you.

Sizing aid

1 Pa/m
Size the duct system based on 1 Pa/m pressure drop. It is never wrong to size using a lower pressure drop/metre of ducting. You can also employ ducting having a constant duct diameter.

40 m
The max. permissible duct length (zone) is 40 metres. If the zone is longer, you should size the duct system accordingly.

2/3
Position the pressure sensor 2/3 of the distance out in the duct.

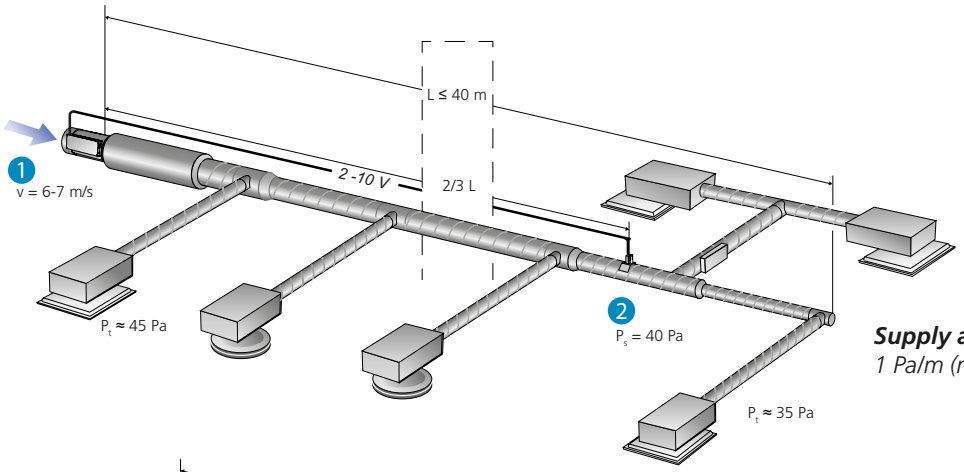
40 Pa
Reference pressure, approx. P_s=40 Pa. This may require adjusting, but should be correct if you follow the above items.

6-7 m/s
Zone damper approx. 7 m/s (max flow). This is in order to achieve adequate measurement inaccuracy under min. flow conditions.

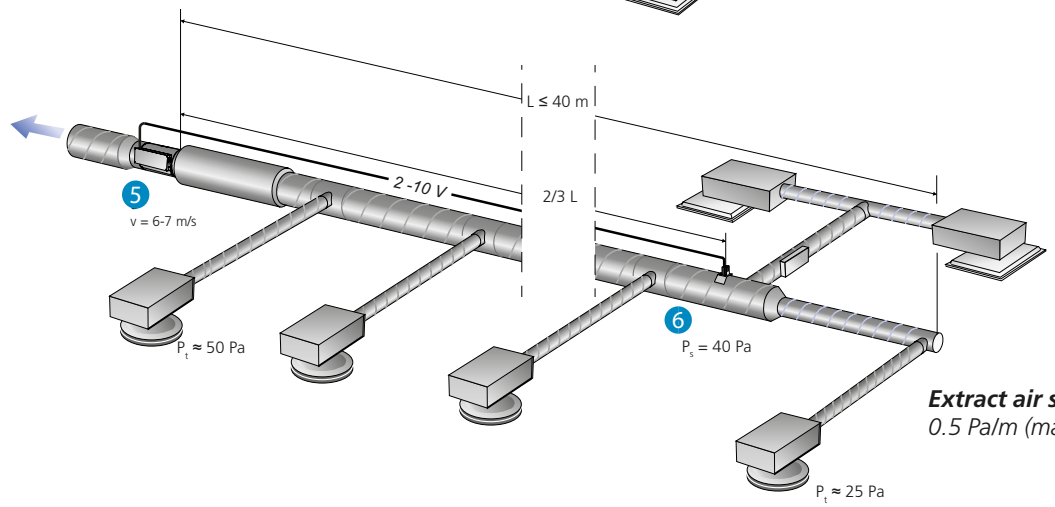
Example 1

Balance at room level

All the rooms in the zone are in balance, both of the zone dampers (1 & 5) operate completely individually to achieve their respective pressure setpoints (2 & 6). In this example, CONTROL Dampers are used for both the supply air and extract air flows. Possible constant airflows, in toilet groups and other spaces, are let out into the extract air duct where the pressure is constant.



Supply air system
1 Pa/m (maximum airflow)

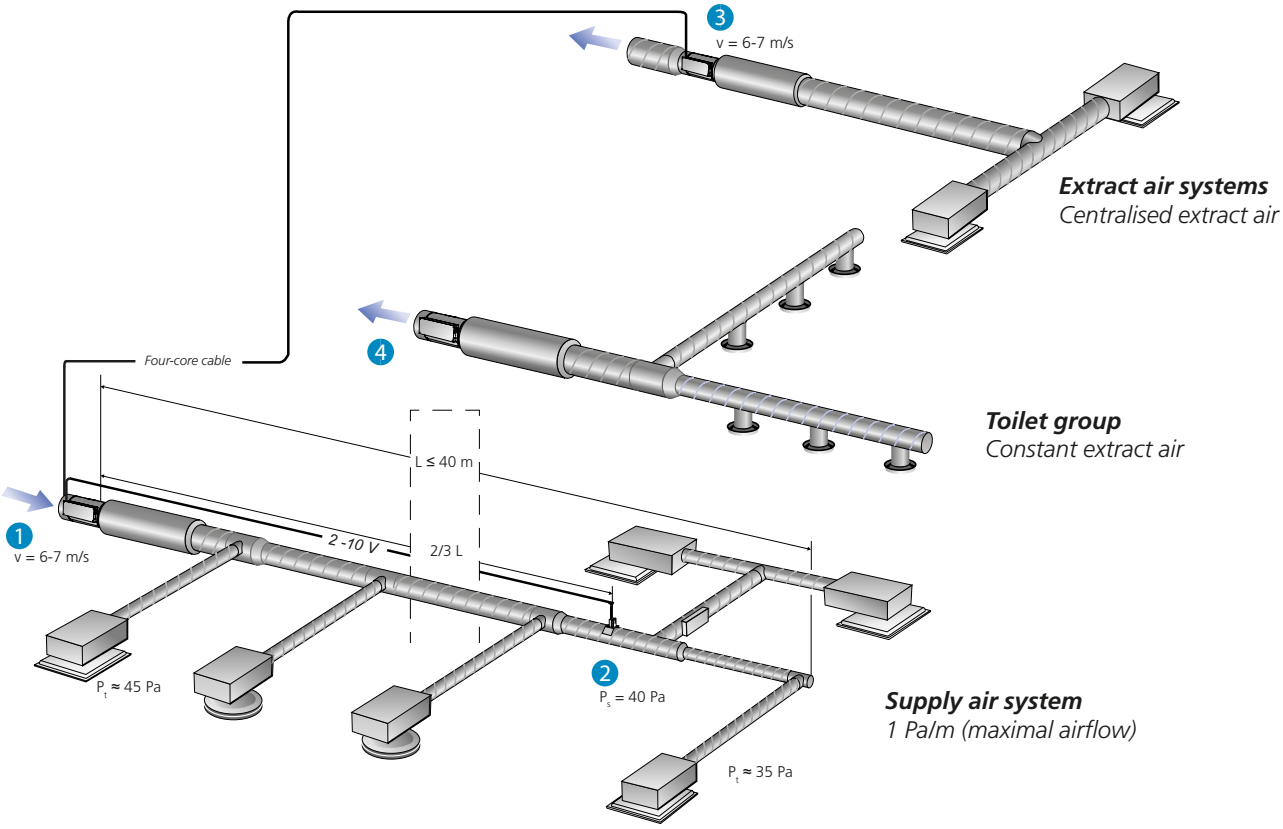


Extract air systems
0.5 Pa/m (maximum airflow)

Example 2

Balance at zone level

CONTROL Damper (1) maintains constant pressure in the supply air duct; at the same time the total supply airflow of the zone is measured. CONTROL Damper also controls the flow through the extract air duct by means of the SLAVE Control slave damper (3). The SLAVE Control has no controller of its own; it is completely dependent on CONTROL Damper. For possible toilet groups, CONTROL Damper (4) is used as a constant flow damper. In order to compensate for the flow required by the toilet groups, an offset value is entered into the supply air damper, which is subtracted from the slave controlled flow of SLAVE Control.

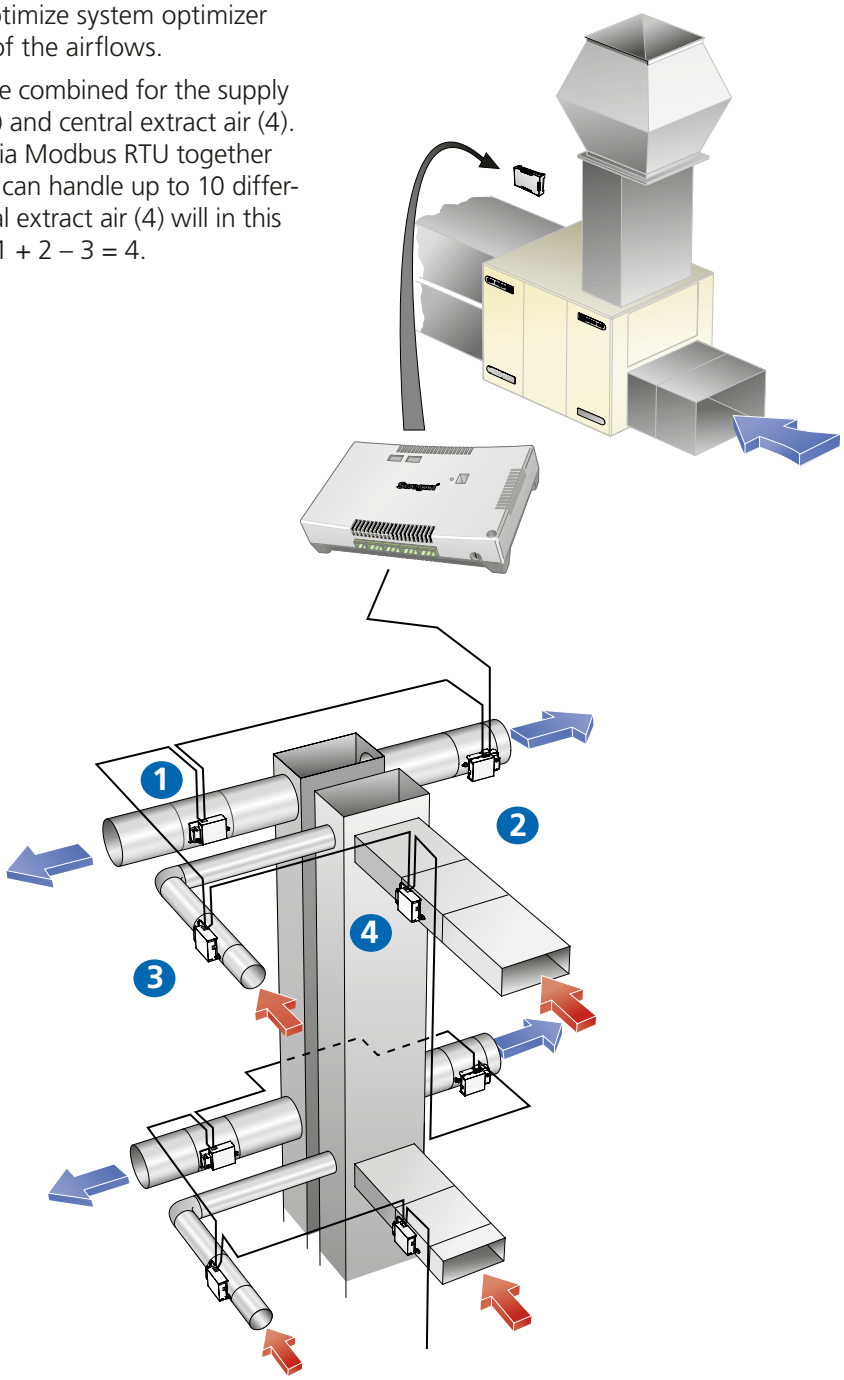


Example 3

More than one zone damper for supply air and extract air respectively in the same zone

Proposed breakdown of the zones in accordance with the preceding two examples provide a simple and clear zone breakdown, which however is not always possible. Due to e.g. the layout of the storeys or the location of the shaft, sometimes there is a need for combining two or several supply air or extract air dampers with one another. This may make the addition and subtraction of flows a bit more extensive. In these cases, CONTROL Damper is used for all dampers within the zone. The system is also supplemented with a CONTROL Optimize system optimizer which manages all summation of the airflows.

In this case, two branch ducts are combined for the supply air (1 and 2), one toilet group (3) and central extract air (4). All the dampers are connected via Modbus RTU together with CONTROL Optimize, which can handle up to 10 different zones. The sum of the central extract air (4) will in this case be the flow from dampers 1 + 2 – 3 = 4.



Air handling unit

Operation

When you select a GOLD air handling unit, among others, the following useful functions are included as standard:

- Filter monitoring (adapted to the flow, perfect for variable airflows).
- Zero point calibration (is performed if the fans stop for more than three minutes).
- Carry over Control (guaranteed purging of heat exchanger rotor regardless of the airflow).
- Built-in web server (dynamic flow image).
- Communication with main control system.
- Logging function, reading SFP, flow, temperature and more.
- Well developed alarm management.

The advantage with a demand controlled ventilation system is that there seldom or never is any maximum flow demand in the whole system at the same time. Therefore in larger systems you can calculate with a diversity factor (70-90%), when sizing the air handling unit and main ducts.

If the ventilation is decentralised, the air handling unit should however be sized according to maximum airflow. The cooling unit must be able to manage variable airflows and stepless cooling is recommended. It is beneficial to utilise control functions such as constant supply air temperature with outdoor temperature compensation and summer night cooling if WISE is combined with a GOLD unit.

Sizing of air handling units

Since all flow control takes place out in the system, the unit should be set for constant pressure control. A system with a central air handling unit should be pressure controlled both on the supply air and the extract air sides. If decentralised ventilation is used, the supply air system is instead usually maintained at constant pressure while the extract air fan is slave controlled on the basis of the supply airflow. The supply air temperature should be constant with opportunity for compensation depending on outdoor temperature.

Air flows

If the air handling unit is located centrally in the building, it is possible to utilize a diversity factor, provided that the design flow never will occur in all parts of the building at the same time. Based on these prerequisites, it is possible to select a smaller air handling unit. If the ventilation is decentralised, the unit should be sized for design airflow.

It is important that the total min. flows of the system are not below the recommended min. permissible flows of the air handling unit.

- Decentralised air handling units: 100% of maximum flow.
- Central air handling unit: 70-90% of maximum flow.

Figure 17. GOLD.

Recommended control functions

- Fan regulation, constant pressure.
- Constant supply air temperature (15 °C) can be supplemented with compensation for outdoor temperature, if needed.
- Summer night cooling, requires Modbus RTU-communication down to room level.
- Slave controlled extract airflow, for decentralised ventilation and central extract air only.

To consider

The question of whether an air heater is required or not depends on conditions in the building, selection of heat exchanger and the building's geographical location, and must be decided from one case to another.

Further information about interfaces, protocols and configuration is available at www.swegon.com.

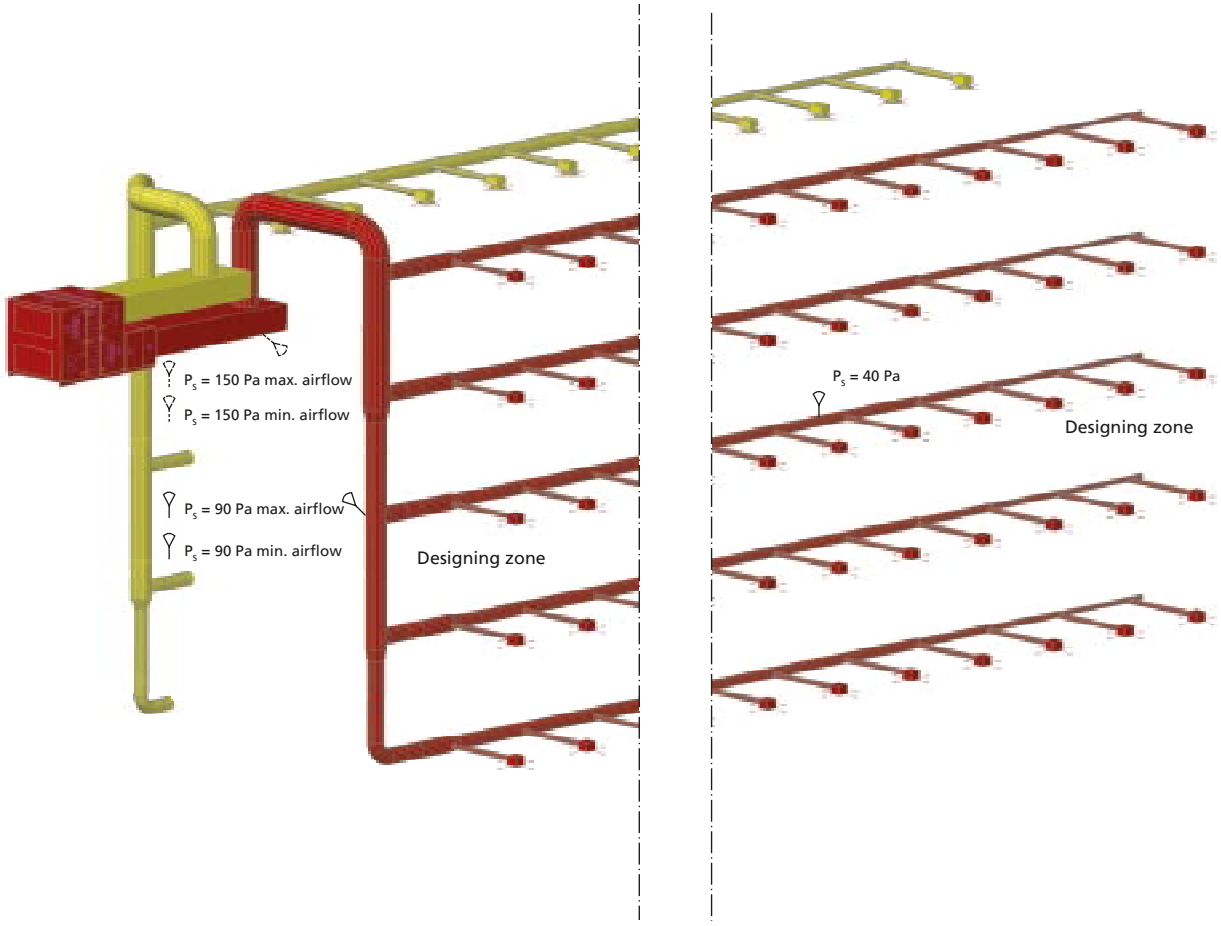
Location of the air handling unit pressure sensor

One important factor for a quiet and energy efficient demand-controlled ventilation system is sensor location. The supply air and extract air pressure sensors respectively must be correctly placed. The pressure sensors should be placed out in the system close to the zone located at the worst spot in the system (for design flow). With this location, the flow variations can be found earlier and the air handling unit can correct the pressure instead of letting the room and zone products do the compensating. This decreases the noise levels out in the system, at the same time as it decreases the number of motor movements, which in turn increases the useful life of the equipment.

With the pressure sensors located out in the system, the total pressure increase of the air handling unit for all the airflows decreases, except when the air handling unit is operating to generate the design max. flow, which almost never occurs. This means that the air handling unit operates during the rest of the time to achieve an unnecessarily high reference pressure, regardless of whether this is about decentralised ventilation or a centrally located air handling unit.

The image below illustrates the difference between locating the pressure sensors close to the air handling unit and locating them by the design zone.

If CONTROL Optimize is used in combination with the CONTROL Damper zone damper, there is no need for moving out the pressure sensors. CONTROL Optimize senses all blade positions of the zone dampers and therefore always has a reference point out into the system, which provides information as to whether the pressure of the air handling unit should be increased or decreased. This also reduces the installation costs because the pressure sensors do not have to be fitted out in the system.



System optimisation

Figure 18. CONTROL Optimize.

Control of static pressure in branch duct
Active air diffusers assume that you have control over the static pressures in the branch duct upstream of the air diffuser. In order to comply with this condition a pressure sensor is installed (DETECT Pressure) 2/3 out in the branch duct. This pressure sensor is connected to a zone damper (CONTROL Damper). Depending on whether the diffusers in the zone increase or decrease in flow, the zone damper sets itself to always maintain the required pressure. A system can consist of many zones, which work completely independent of one another.

The function of the zone damper is important, it breaks down the system into smaller sections and takes care of the excess pressure that all zones except the design zone receive. The noise generated by the damper is reduced by a sound attenuator. The zones also react much quicker to flow changes than they would if the air handling unit located centrally and in this way enables much fewer motor movements out in the ventilation system.

If the system is not broken down into zones, all the air diffusers in the ventilation system, except one (the temporary design damper), will need to throttle away the excess pressure of the air handling unit. This involves risk for acoustic problems at room level. If supply air diffusers with active slot are used, the throws will be very long. Decentralised ventilation (the system is broken down into smaller sections by using smaller air handling units) can be compared with the zone damper's operation which then can be deselected.

How does the air handling unit manage this?
Since every zone is pressure controlled, the air handling unit must also be pressure controlled however at system level, i.e. in the main duct/ducts (shafts). In order to obtain good balance in the system, the pressure sensors for the air handling unit must be located at the zone that requires the highest pressure (the design zone). This zone is usually the one that is farthest away from the air handling unit.

What happens at min. flow?
The static pressure that the air handling unit should maintain must be based on design pressure, even if the flow is much lower during the greater part of the year. Whenever the design flow is not used, one or two zone dampers will be more or less closed. At night, when the flow is very likely decrease to the hygienic flow in the greater part of the building, all the zone dampers will be closed to a great degree.

System optimisation
The CONTROL Optimize system optimizer communicates with the air handling unit and all the zone dampers (CONTROL Damper) via Modbus RTU protocol. A damper blade angle reading (0 – 100%) is transmitted from the zone dampers to the system optimizer which chooses the damper that is most open. If this damper is completely open, the system optimizer transmits a new pressure setpoint that is higher than the current actual value to the fan. The fan now accelerates up to the new setpoint and the most open damper closes slightly to ensure the pressure in this branch.

If the flow decreases in the system, for example at lunch time, the most open damper will be less open than it was in the previous case. The system optimizer does now the opposite of what it did in the previous case and transmits a lower pressure setpoint to the fan until the most open damper is almost completely open (85%). 60 dampers can be connected to CONTROL Optimize, 30 supply air and 30 extract air dampers respectively. The advantages of a system optimizer are that you reduce the noise generated by both the fans and the ducting in the ventilation system and also reduce the consumption of power at airflows lower than the maximum flow. The system optimizer also facilitates adjustments and commissioning because the pressure setpoints for the fans do not need to be "sought after".

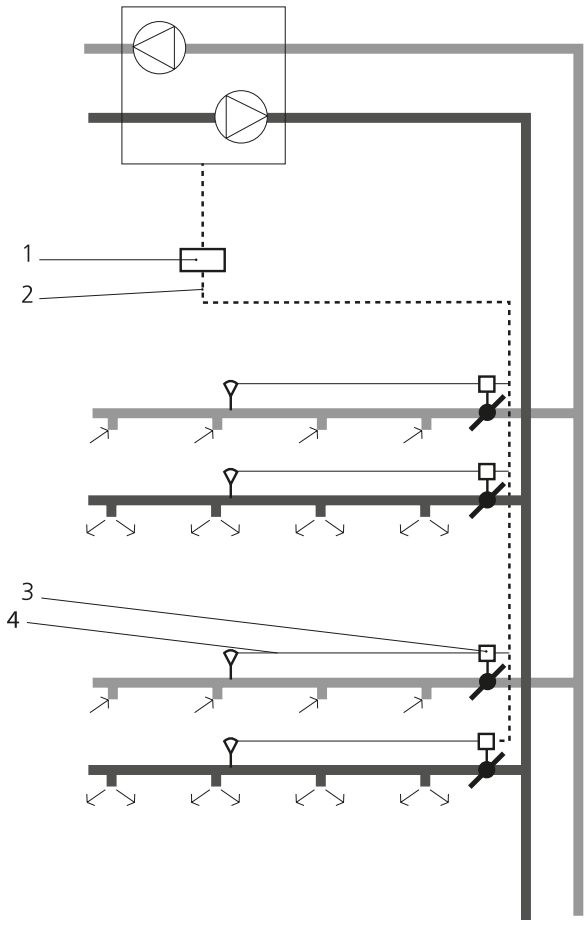


Figure 19. Pressure control with the CONTROL Optimize
1. CONTROL Optimize
2. Modbus RTU communication
3. CONTROL Damper
4. 2-10 V

System optimising with the GOLD

If Swegon's unit the GOLD is used in combination with CONTROL Optimize, no main control and monitoring system in forwarding the pressure setpoint to the air handling unit is needed.

The GOLD unit has a built-in control function, where you can read that the CONTROL Optimize has been switched in. Then the air handling unit senses that it is the system optimizer that sets the pressure setpoint. Moreover, a new tab specifying all zone dampers connected under the system optimizer with specified damper positions is created on the web page of the GOLD unit. This provides a quick overview of the system and commissioning.

Sizing

- It is very important that the various zones of the duct system are uniformly sized (the same pressure drop). If one zone requires higher pressure, it will become dominant over the air handling unit pressure.
- The above must be considered especially carefully if central extract air at zone level or toilet groups with separate zone dampers are used, since the extract air devices (ordinarily control valves) are adjusted with relatively high pressure drops across them. This zone then has a tendency to become the dominating zone.
- CONTROL Optimize communicates via the Modbus RTU with all zone dampers (CONTROL Damper).

Accessory, CONTROL Optimize

TUNE Control is a hand-held micro terminal for entering settings in the system optimizer, the grouping of zone dampers and setting the air handling unit, see the preceding spread.

Figure 20. TUNE Control.

Communication

Main control functions

A system that is able to communicate via Modbus on various levels is required in order to be able to use the main control functions.

Modbus RTU

All the products in the WISE system are capable of intercommunication via the open Modbus RTU protocol. The Modbus variables for all the products can be downloaded from www.swegon.com.

The system works excellently in the “Stand-alone" version, which means that air diffusers and dampers do not need to be connected up to a main control system in order to obtain full functionality.

To optimize the pressure in the fans.

The task of optimising the pressure in the fans requires that the system contains a CONTROL Optimize system optimizer. The system optimizer communicates with all the subordinate CONTROL Damper zone dampers via Modbus. This function requires Modbus communication at zone level.

Emergency function

All the WISE products can be completely open or completely closed in the event of an emergency situation. The GOLD air handling unit has an internal fire function that can activate the emergency function of the air diffusers and dampers respectively. Signals can also be transmitted from an external system via the GOLD to all the air diffusers and air registers. This function requires Modbus communication at zone level.

Summer night cooling

Summer night cooling is a function that enables you to utilize lower outdoor temperatures at night for cooling the building structure while there are no occupants in the rooms. The cooling power is accumulated in the building structure and in this way helps to maintain the right temperature. This function requires Modbus communication at zone level.

WISE in combination with a main control system

Today’s CONTROL Optimize communicates via Modbus RTU only. The above function can also be controlled by an external BMS. During 2009 SWEGON will supplement WISE with additional functionality for external main control systems, and additional communication protocol options as well.

The Modbus structure with WISE

Swegon's CONTROL Damper zone damper acts as a router and divides the network into smaller parts. All the air diffusers and room dampers in one zone should be wired to the same loop, a so-called zone loop. A zone usually consists of two or more zone dampers. We suggest that you choose a supply air damper as a router with all the room products subordinate to it. The room products are Modbus slaves and the zone damper is the Modbus master.

All the zone dampers in the ventilation system are wired together on the same loop, a so-called system loop, under the CONTROL Optimize system optimizer. In this loop, CONTROL Optimize is the Modbus master and all the dampers should be wired as Modbus slaves. Note that also the zone dampers that do not have a subordinate zone loop wired to them must be wired to CONTROL Optimize.

Preconfigured from the factory

All the Swegon products can be supplied preconfigured from the factory, with the design flows, temperature requirements, control functions, marking, Modbus speed and Modbus address.

In that all the products within the same loop have unique Modbus addresses, CONTROL Optimize automatically finds all the zone dampers, and therefore can also further transmit information to room products that are subordinate to the zone damper.

The room products have such a so-called commissioning setting that enables them to operate to achieve maximum airflow, until they are switched out of the commissioning setting. All this put together offers enormous advantages when it comes to installation, adjustment and commissioning.

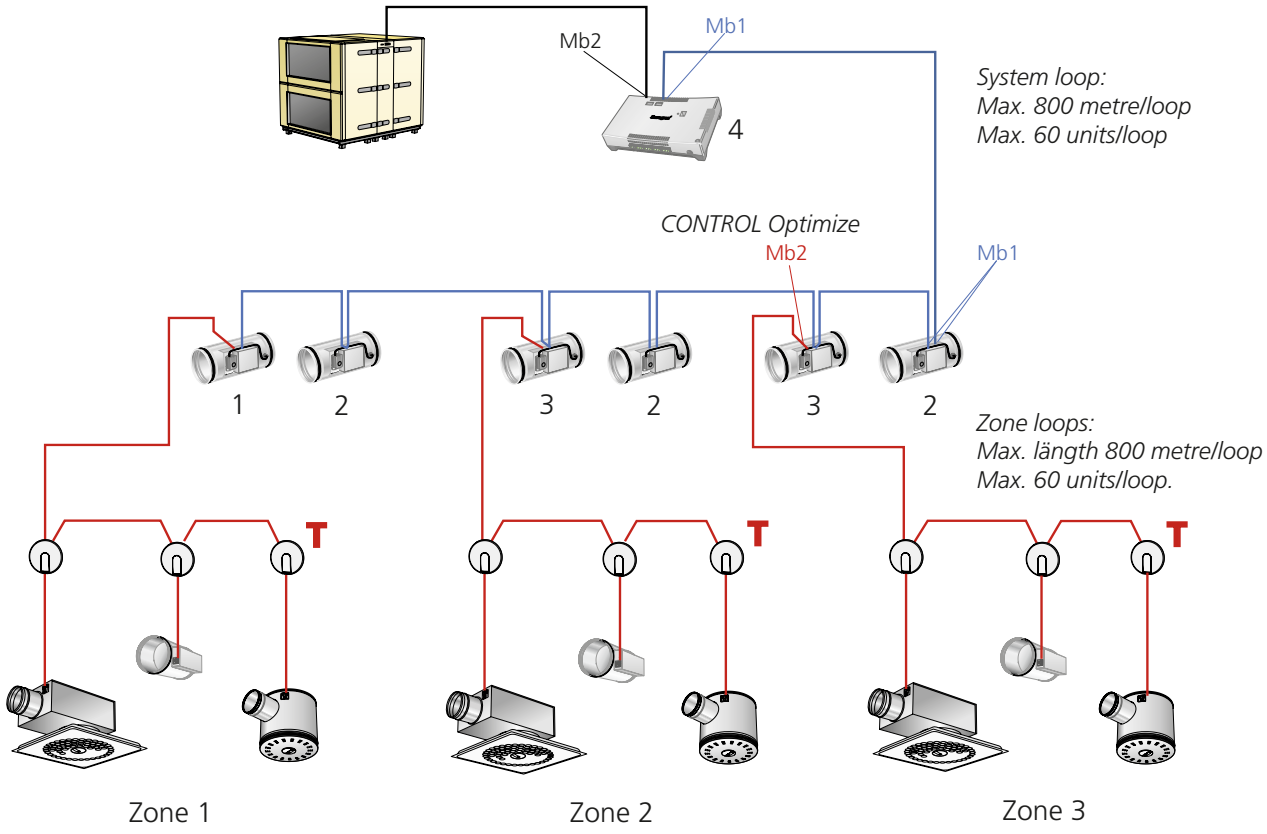


Figure 21. Schematic image of a Modbus network, where WISE is used in combination with a GOLD air handling unit.

Communication with slave units

In the WISE system, as a rule only the master air diffuser is connected up to the main control system (the RJ12 cable is connected between the air diffuser and the CONNECT Adapt junction box). Note that all the slave air diffusers are controlled in analogue mode via a 2 – 8 V signal. If you also want to communicate with and check the slave air diffusers, these must also be connected up to the main control system. This is most easily done by supplementing the slave air diffusers with a LINK Modbus (RJ12 cable) and a CONNECT Adapt, figure 29. Keep in mind that LINK Adapt (the RJ12 cable) from the slave air diffuser must be run to the junction box of the master air diffuser. As an alternative, the modbus cable can be connected from slave to slave via a SPLIT Link-12, figure 30.

N.B.! The total length of a Modbus cable must be a maximum of 10 metres.

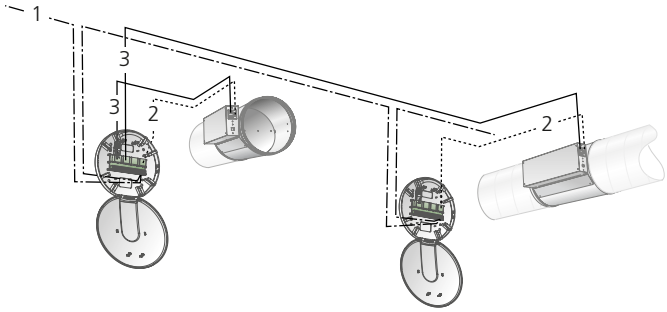


Figure 29. Alternative Modbus connection of slaves with CONNECT Adapt.
1 Modbus RTU
2 LINK Modbus RJ12 cable
3 LINK Adapt RJ45 Internet cable 24AWG

WISE in combination with the GOLD

Further advantages can be achieved by combining the WISE system with a GOLD air handling unit. Particulars on how to connect a CONTROL Optimize are specified either in the hand-held micro terminal of the air handling unit or on the web page dealing with the GOLD. After connection has been completed, the air handling unit will "know" that the system optimizer determines the pressure setpoint. All that is required is Modbus communication between CONTROL Optimize and the GOLD air handling unit. A new tab on the GOLD air handling unit web page is now shown and presents all the subordinate zone dampers and specifies their respective damper blade positions.

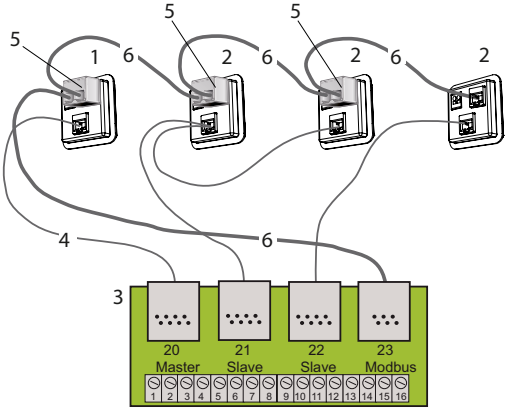
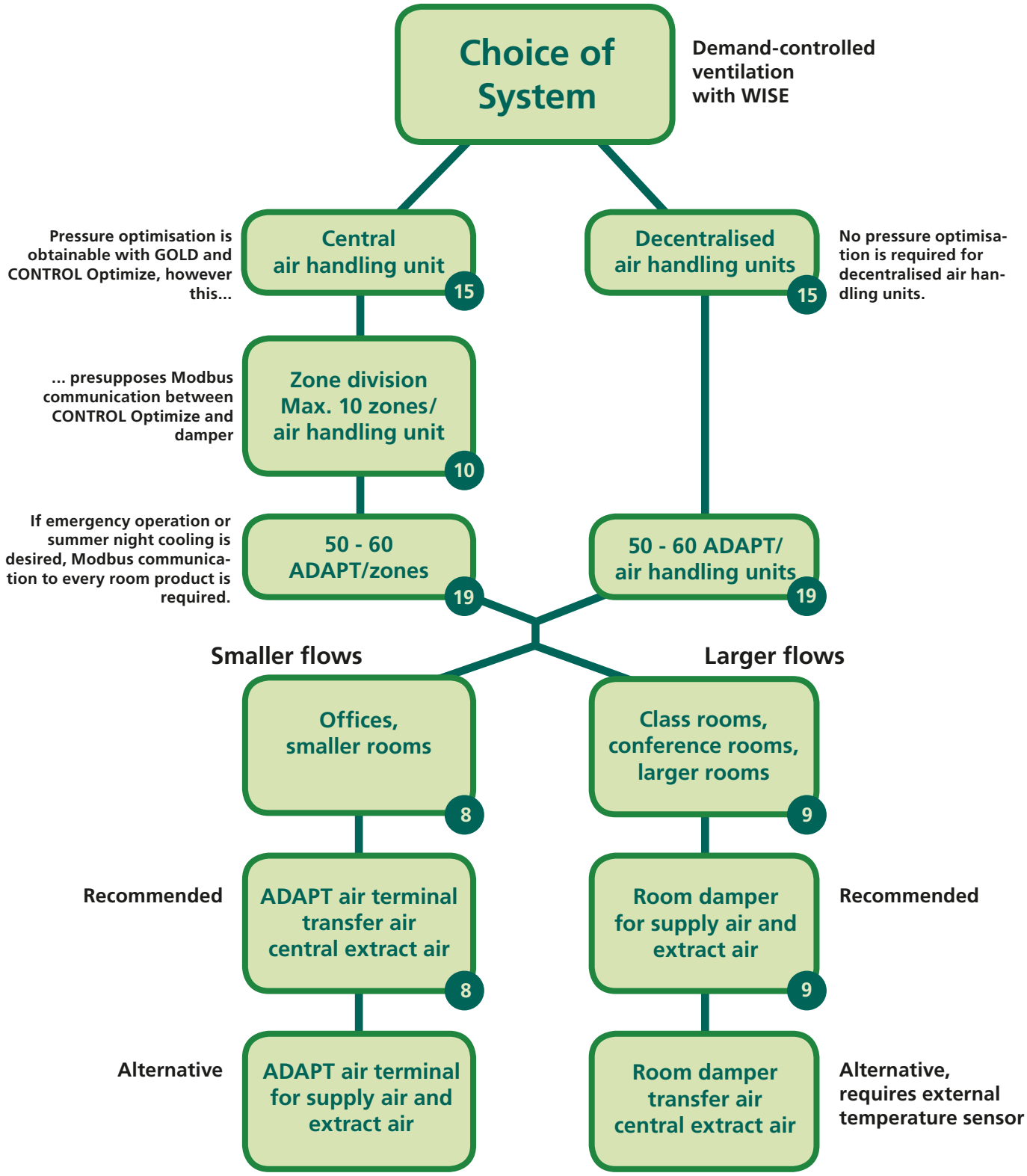


Figure 30. Connection with LINK Modbus
1 The air terminal contact in the master air terminal
2 The air terminal contact in the slave air terminal
3 The interconnection card in CONNECT Adapt
4 LINK Adapt, RJ45 Internet cable 24AWG
5 SPLIT La 12 branch contact RJ12
6 LINK Modbus RJ12 cable.

Project planning – Choice of system



15 = page reference

Project planning – Air terminals

Rooms

In demand-controlled ventilation, the air is utilised for ventilating as well as for air conditioning. It is therefore important to be able to use air below room temperature. When air below room temperature is discharged into the room, it must be possible to reduce the airflow when the heating load drops, otherwise the room will become uncomfortably cool.

Here are suggestions as to how products for two different types of room can be sized. You can slso find these examples below the sizing example for room products.

Office, 10 m²		Heating load	Hygiene	Climate
ΔT = 8K)	Basic ventilation	–	4 l/s	–
	1 person	100 W	7 l/s	–
	1 computer	150 W	–	15 l/s
	Lighting	100 W	–	10 l/s
	Solar radiation	100 W	–	10 l/s*
Airflow needs	Vacancy	4 l/s		
	Occupancy, min.	11 l/s		
	Occupancy, max.	45 l/s		

*Vary depending on windows, solar protection, point on the compass, etc.

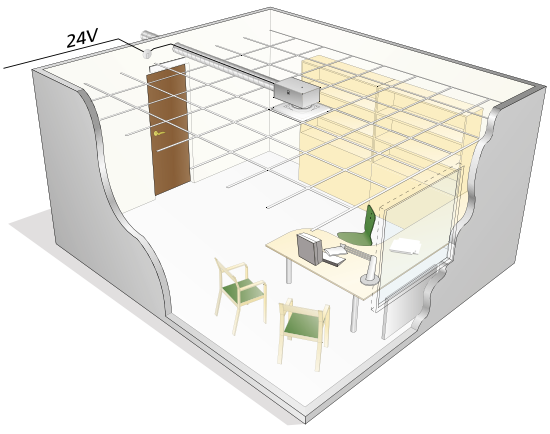
In this case we suggest active supply air diffusers, transfer air and a centrally located extract air register.

Recommended room control:

Temperature	Integrated into the air terminal
Occupancy	Integrated into the air terminal

Supplementary accessories and operation:

Radiator valve actuator	Control of radiators in sequence
Setpoint selector switch	Room temperature setpoint displacement



Conference room, 25 m²		Heating load	Hygiene	Climate
ΔT = 8K	Basic ventilation	–	9 l/s	–
	15 persons	1500 W	105 l/s	–
	Computers and projectors	300 W	–	30 l/s
	Lighting	200 W	–	20 l/s
	Solar radiation	300 W	–	30 l/s*
Airflow needs	Vacancy	9 l/s		
	Occupancy, min.	105 l/s		
	Occupancy, max.	230 l/s		

*Vary depending on windows, solar protection, point on the compass, etc.

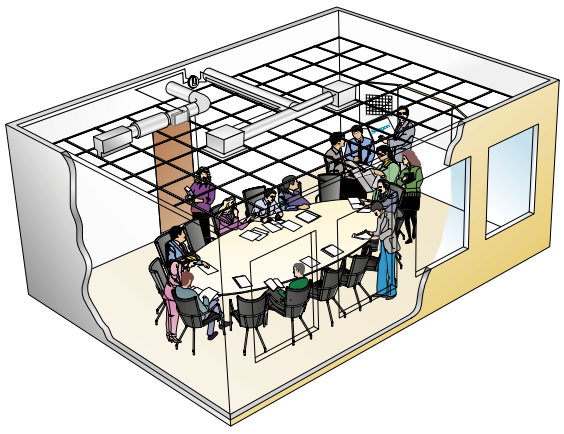
Correct balance is recommended in rooms, such as conference rooms, in which it is important to prevent acoustic disturbance. We suggest using active room dampers for supply air and extract air in combination with "ordinary" air terminals. Air diffusers equipped with air discharge discs are preferable because they manage air below room temperature and variable flows extremely well.

Recommended room control:

Temperature	Integrated into the damper
Air quality	Integrated into the damper (Clean Air Control)
Occupancy	External sensor

Supplementary accessories and operation:

Radiator valve actuator	Control of radiators in sequence



Project planning – Air flows

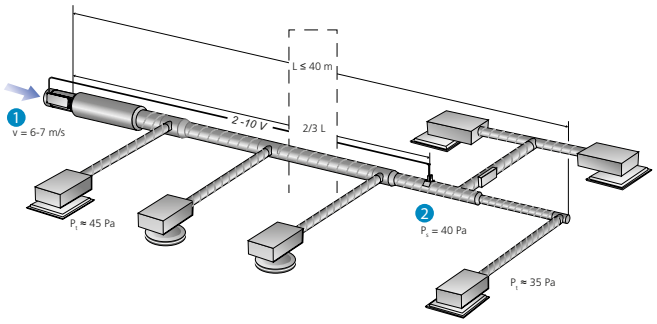
Zone

Zone dampers serve an important function by maintaining a constant pressure in the zone. In this way supervision of the static pressure for the system is divided up into smaller parts, which gives rise to quicker reaction to changes in pressure, fewer motor movements and longer useful product life.

The pressure rise in the zone duct should be sufficiently high to enable achieving design airflow in all the air diffusers. Further pressure rise from the air handling unit is managed by the zone damper.

The zone damper should be sized based on an air velocity of 6 – 7 m/s at the design max. flow. To obtain food measurement accuracy under minimum flow conditions, the min. flow of all the rooms must be summed up and checked in relation to the flow limits of the zone damper. If required, the min. flows will have to be increased slightly in order to be within the limits of the damper.

This applies also to the duty range of the air handling unit (see Sizing, air handling units).



An example is given below as to how a zone might look:

Type rooms	Quantity	m²	Min. (l/s)	Max. (l/s)	Min. zone (l/s)	Max. zone (l/s)
Offices	16	12	4	45	64	720
Conference	2	25	9	230	18	460
Coffee break room	1	40	14	240	14	200
Other areas	1	318	120	500	120	500
		600	0.36 l/s m²	3.20	126	1920

In this example, the total min. flow is below the recommended airflow for the zone damper. The same zone with corrected airflows is shown below.

	Recommended airflows	
	q_{min} (1 m/s)	q_{max} (7 m/s)
Ø 250	49	344
Ø 315	78	546
Ø 400	126	880
Ø 500	196	1374
600 x 400	240	1680
700 x 400	280	1960
800 x 400	320	2240
1000 x 400	400	2800

Proposal with increasing min. flows

Type rooms	Quantity	m²	Min. (l/s)	Max. (l/s)	Min. zone (l/s)	Max. zone (l/s)
Office	16	12	5	45	80	720
Conference	2	25	15	230	30	460
Coffee break room	1	40	25	240	25	200
Other areas	1	318	150	500	150	500
		600	0.48 l/s m²	3.20	285	1920

Very small changes must be made and the greater portion of the flow that is added should be distributed to open areas to avoid chilling individual rooms.

Project Planning – Airflows

Air handling unit

Max. and min. airflow for the building

Calculate the max. and min. airflows for the project this example is based on the four type rooms that were previously used for sizing the zone dampers.

When sizing an air handling unit for demand-controlled ventilation, it is not possible to size on the basis of the demands on SFP placed on CAV ventilation systems. It is important not to oversize the air handling unit so that its air heater will be able to manage the min. flows in the system.

Moreover you can take a diversity factor into consideration for the max. airflow of the air handling unit, in this example 80%.

Even if you strive to obtain as low flows as possible with demand-controlled ventilation, it is important to ventilate the building. We therefore recommend that the airflow is not lower than 0.35 l/s m².

If the total min. flow of the system drops lower than recommended min. flow for the selected air handling unit, the min. flows of the system must be increased and, as a suggestion, must percentage-wise be distributed evenly throughout the ventilation system.

It is possible to size for low SFP values, but then you must take into account that the min. flow will be higher. Depending on operating times for the various operating conditions, the use of energy as a whole may be higher for a larger air handling unit with a low SFP owing to the long operating periods with higher min. flow than what a smaller air handling unit uses.

Swegon recommends the GOLD air handling unit since they have a larger working range than the majority of the air handling units with plenum fans available on the market.

Post air treatment

The air handling unit in the building can of course be supplemented with post air treatment for heating and cooling respectively in order to guarantee correct supply air temperature. As an extra heating source, an electric as well as a water coil-type air heater can be selected. Depending on which type of post heating you choose, the supply air temperature may periodically fluctuate to a certain degree in consequence of the control function of the electric air heater. Over a longer time, five minutes, the temperature will be relatively constant.

Pressure optimisation

To the right, we have specified the working range for the example above.

If the duct system is correctly sized and we have equipped the air handling unit with pressure optimisation (CONTROL Opimize), the pressure rise will drop in step with the airflow and thus follow the operating line of the fan.

This provides lower pressure losses, lower SFP and thus lower operating costs than without pressure optimisation.

The diagram curves indicate the principle, and the benefit, of using CONTROL Optimize.

Without CONTROL Optimize

With CONTROL Optimize

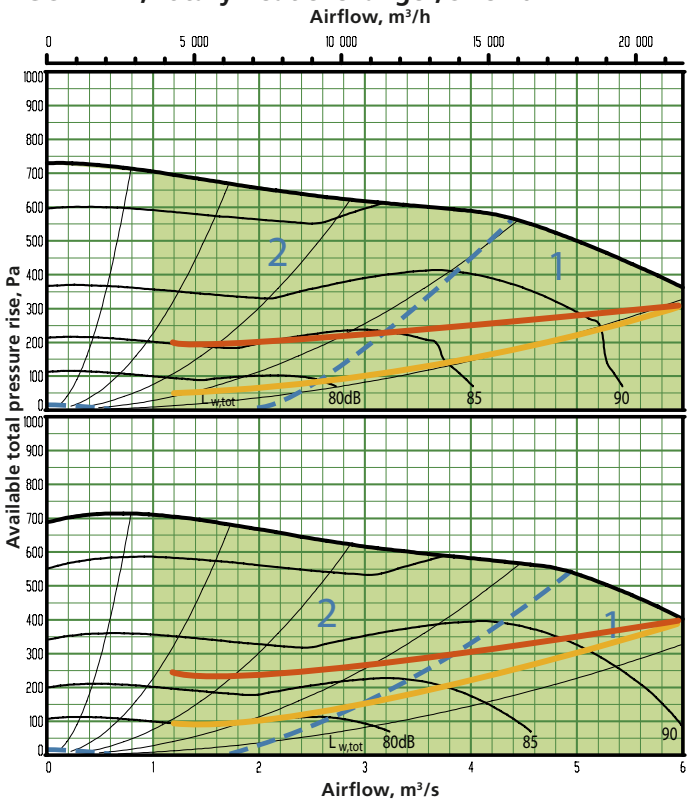
8 example zones are used for sizing air handling units, two zones per storey in a 4 storey building.

Type rooms	Quantity	m²	Min. l/s*m²	Max. l/s*m²	m²/s	m²/s
Office	128	12	0.4	3.8	0.65	5.76
Conference	16	25	0.6	9.2	0.24	3.68
Coffee break room	8	40	0.6	6.0	0.20	1.60
Other areas	8	318	0.5	1.6	1.20	3.99
			0.48	3.20	2.28	15.35

		Diversity factor	Quantity GOLD RX	Airflow Min.	Airflow Max.
Atemp	4,000 m²	80%	2	2.28	12.28
			m³/s per GOLD	1.14	6.14

GOLD RX	Length	Width	Height	Weight	Duct connection	Airflow, m³/s		
	mm	mm	mm	kg	mm	Min.	250 Pa	Max.
04	1500	820	1020	260	Ø 315	0.08	0.42	0.45
05	1500	820	1020	260	Ø 315	0.08	0.42	0.62
08	1600	990	1185	315	Ø 400	0.10	0.72	0.90
14	2080	1295	1495	640	1000x400	0.20	1.10	1.10
20	2080	1295	1495	640	1000x400	0.20	1.50	1.80
25	2220	1595	1795	840	1200x500	0.30	2.20	2.20
30	2220	1595	1795	840	1200x500	0.30	2.50	3.00
35	2300	1885	2085	1100	1400x600	0.60	3.10	3.10
40	2300	1885	2085	1100	1400x600	0.60	3.40	4.10
50	2670	2318	2376	1690	1600x800	0.80	4.60	4.60
60	2670	2318	2376	1690	1600x800	0.80	5.00	6.00
70	3070	2637	2752	2379	1800x1000	1.00	6.30	6.30
80	3070	2637	2752	2379	1800x1000	1.00	7.00	8.20

GOLD RX, rotary heat exchanger, size 70



Complete documentation is available at
www.swegon.com

EN-WISE Technical Section, 2009-11-30

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