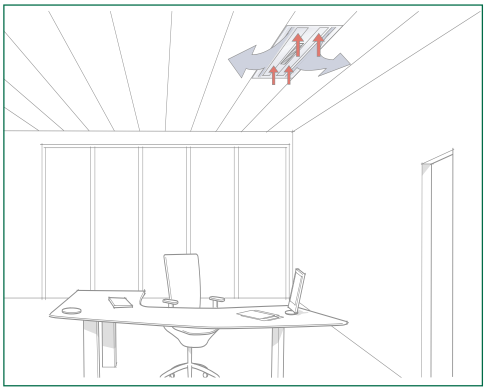
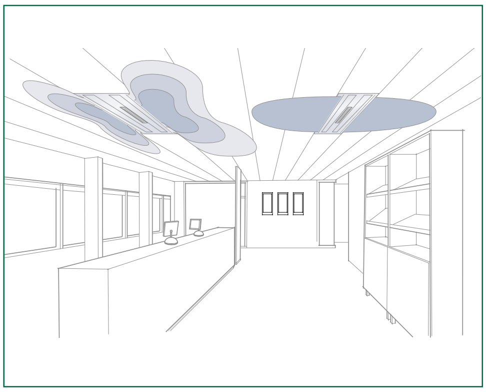
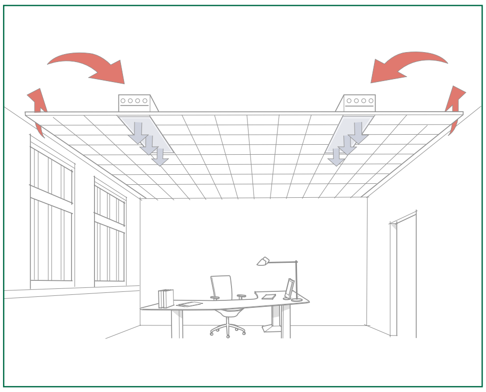
Project design guide - Chilled beams



Chilled beams


IQID


IQFC


IQSA


QPSA, QPBA


QPDA


IQTA

Chilled beams

IQ beams are supply air beams with a covered upper surface, which reduce noise and overhearing and are provided with a comfort control (adjustable hole length for the supply air), which permits adjustment of the capacity and diffusion pattern and offers the possibility of good air comfort in the room.
The air is admitted from below, which gives good accessibility for inspection and service.

QP beams are passive chilled beams which operate by convection without supply air. The dimensioning of chilled beams is best performed with reference to the Fläkt Woods WinDon product selection program.

Assortment – chilled beams

Choice of execution, function and position

Beam type	Cooling with supply air – Supply air beam				Cooling without supply air – Passive chilled beams		
Function and position	**IQID**	**IQFC**	**IQSA**	**IQTA**	**QPSA**	**QPBA**	**QPDA**
Covered upper surface - Room air from below	●	●	●	●	–	–	–
Open upper surface - Room air from above	–	–	–	–	●	●	●
Built into false ceiling	●		●	–	(●)	(●)	
Freely suspended	–	●	–	●	●	●	●
Heating loop as an option	●	●	●	●	–	–	–
Lighting as an option	–	●	–	–	–		●
Greatest length in m	3,6	3,0	3,0	3,0	4,2	4,2	4,2
Visible width in mm	593	447	295	387	290	430	400
Total width in mm	593	447	295	387	290	430	400

Chilled beam function, quick selection

Chilled beam function

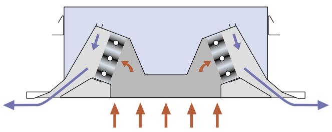
A system with chilled beams is based on the principle of distributing the cooling with cold water and dimensioning the supply air to meet the requirement for good air quality.

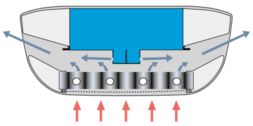
Supply air beams (also known as active beams) operate with induction. The incoming supply air brings room air with it, which is sucked in through the coil of the beam.

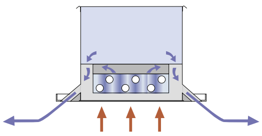
The total flow, which is the sum of the supply air flow and the circulation air flow, arrives through the outlet slot of the beam. The circulating air flow with room air is 3-4 times as large as the supply air flow.

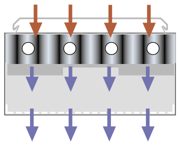
Passive beams work with a reverse chimney effect, which means that the cooler air inside the beam has a higher density than the surrounding air. The difference in density in combination with the height of the beam forces circulating room air through the coil of the beam.

Fläkt Woods has a complete range of air conditioning beams for the majority of needs, in which great importance is attached to the function in order to achieve optimal comfort in the room.


IQID


IQFC


IQSA


QP(S,B,D)A

Supply air beams

IQID, IQFC, IQTA and IQSA are a new concept with many advantages. They have a covered upper surface, which reduces noise and overhearing, and are provided with a comfort control (adjustable hole length for the supply air, optional for IQID) for adjusting the capacity and diffusion pattern. The air is admitted from below, which gives good accessibility for inspection and service.

IQID are intended for installation in a false ceiling. The width is adapted to the 600 mm false ceiling module. IQID chilled beams are available in a basic model, but they can also be equipped with a number of functions to provide a multifunctional chilled beam. The following functions are available for IQID: heat, comfort control, FPC air deflector, function for increased air flow, control and regulation equipment, lighting and preparation for a sprinkler system.

IQFC are intended for freely suspended installation and offer the major advantage that the air from the beam is directed obliquely up towards the ceiling for optimal air flow in the room. IQFC are also available as a model with indirect lighting.

IQTA is a one-way blowing beam, intended for installation in the ceiling angle. The circulating room air is admitted at the bottom, and the air exits from the beam along the ceiling and into the room. IQTA consists of an IQFC that has been cut vertically along the duct and the coil.

IQSA is intended for installation in a false ceiling and has half the width compared with IQID.

Passive chilled beams

A passive chilled beam (convection beam) has no supply air, but is based on the principle that circulating air is caused to flow down through the cooling coil by gravity flow natural convection circulation. The air flow through the chilled beam is determined by the temperature difference (actually the difference in density) inside and outside the beam in combination with the height of the beam.

It is possible to supply relatively large cooling effects, but since there is no means of controlling the supplied cold air, these beams should not be positioned directly above workplaces.

Quick selection - chilled beams

Approximate cooling effect P_{tot} in W at a water flow q_v 0,05 l/s, Dt of 8° C, pressure drop 60 Pa on the air side and a max sound level 30 dB(A).

Nominal standard length **For a two-way supply air flow**	1,2 m 15 l/s	1,8 m 25 l/s	2,4 m 35 l/s	3,0 m 45 l/s	3,6 m 45 l/s
IQID (pressure drop 70 Pa)	–	765	1045	1325	1540
IQFC	465	750	1040	1330	–
IQSA	375	610	800	1075	–
IQTA (one-way air flow)	–	405 (12 l/s)	540 (16 l/s)	675 (20 l/s)	–
Without supply air					
QPSA/ QPDA	160	280	380	470	560
QPBA	270	410	560	710	840
With heating loop			Approximate P_{coil} heat output in W		
IQID, IQFC, IQSA	1150	1830	2540	3240	–
IQTA (one-way air flow)	1000	1600	2220	2820	–

System and project design

General

Systems with chilled beams are suitable for use to meet high cooling demands and/or where there is a requirement for individual control of the temperature. At normal room heights in offices, for example, the max cooling effect is 80 - 90 W/m2 of floor area. The limit is set by the max permissible velocity in the occupied zone, and high room heights thus provide the opportunity to supply a greater cooling effect.

As in the case of all cooling demand calculation, it is necessary to take account of the building's dynamic and accumulation capacity. Simply adding the "gross effects" together gives a cooling demand which can be approximately 50 % too large.

The supply air flow is responsible for the air quality in the room and in addition provides basic cooling. The maximum recommended under temperature of the supply air is 10° C. In certain cases, the supply air temperature can be compensated for, i.e. increased by a few degrees, with a falling outdoor temperature. The chilled beam covers the rest of the cooling demand. The water flow is varied depending on the demand with the help of a room sensor.

Compared with a system in which the cooling is brought to the rooms entirely with the air, a chilled beam system reduces the space required for air treatment units and ducts.

Supply air/Room air

Supply air beams

Supply air beams with their long slot air diffuser offer the possibility of a maximum supplied cooling effect without the velocity in the occupied zone being uncomfortable. The reason is that the supply air from the beam achieves very good mixing with the room air because the contact surface with ambient air is extremely large. In the maximum case, the outflowing air covers a large part of the ceiling surface.

One-way beams are positioned on a wall, whereas two-way beams are positioned inside the room.

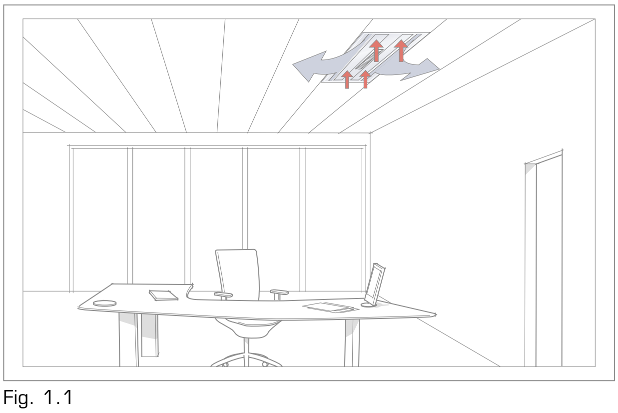


Fig. 1.1

The supply air beam for installation in a false ceiling utilizes the Coanda effect (adhesion effect) in order to cause the air to adhere to the ceiling for a certain distance before it curves downwards.

Fig. 1.2

The covered supply air beam for freely suspended installation also utilizes the Coanda effect to a great extent. As a rule of thumb, in the case of a horizontal outflow, and with a maximum distance of 300 mm between the under edge of the beam and the ceiling, the air jet will be drawn up towards the ceiling and will adhere to the surface.

The possibility for adhesion is strengthened by an upward-angled outflow. The Fläkt Woods WinDon product selection program gives the actual flow pattern with different distances between the beam and the ceiling.

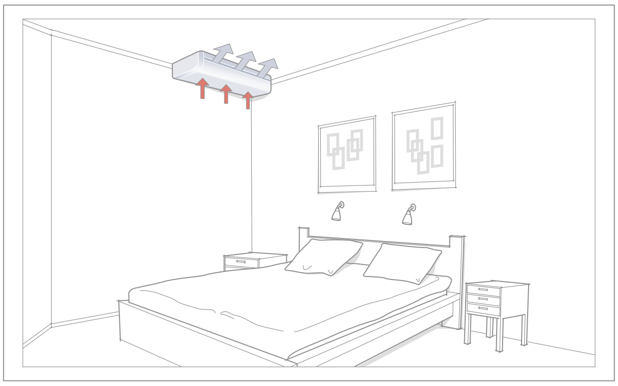


Fig. 1.3

A one-way blowing supply air beam is suitable for certain types of premises, such as hotel rooms. This is preferably installed in the angle of the ceiling with a wet room/corridor and blows the air towards the façade. This provides a simple and adaptable opportunity for connecting water and supply air.

System and project design

Adjustment of flow pattern in the room

Fläkt Woods IQ beams have separately adjustable hole lengths on both sides. This means that the left/right air flows can be adjusted with optional proportions. When beams are positioned close to a wall, for example, the flow towards the wall can be selected at 30 % and in the other direction at 70 %.

Partition walls are often repositioned when rebuilding an installation, and with the help of the adjustable hole lengths, the air flow from each beam can be easily redistributed so that draught problems are avoided. The flow can also be increased or reduced as required. The question of moving the beams seldom arises, therefore.

The adjustability of the hole lengths means that the beam has an integrated damper function. Moderate changes in the pressure/flow can be made without affecting the cooling effect to any great degree.

Even though chilled beams have a short throw, a room with a large cooling demand and high air flows can present the risk of draught problems. In order to avoid this, a number of Fläkt Woods IQ beams have a so-called FPC (Flow Pattern Control) function. This consists of built-in fins in the outlet slots. In lengths of 300 mm, the fins can change the direction of the outgoing air in stages up to 45° by a simple operation.

The consequence of an angled outflow from the beam is that the throw is shortened, measured perpendicularly from the beam.

Shortening the throw by 20 % can be used as a rule of thumb. A beam with FPC can thus be positioned both closer to a wall and closer to other beams compared with a beam without FPC.

Fig. 2

Increasing the supply air flow

To increase the maximum air flow of the IQ beams, they can be provided with double rows of holes on both sides. Compared with IQ beams with single rows of holes, the double holes give an increased air flow and cooling effect for a given pressure drop. The Fläkt Woods WinDon product selection program provides the possibility of dimensioning with double rows of holes.

Passive beams

Passive beams give an essentially downward air flow in the room. At a low room height, it is not acceptable, therefore, simply to position the beam above a work-station with sedentary work, for example, in order to avoid draughts.

In rooms with passive beams, the air is supplied with separate supply air terminal devices. Both remixing and displacement terminal devices provide good comfort in the room in combination with passive beams.

With displacement air handling, the temperature difference between the floor and ceiling will be reduced, although the displacement function will be retained. In rooms without a false ceiling, it is important for the air flows from remixing supply air terminal devices not to disturb the influx of air to the beam, which reduces the beam's cooling effect.

For passive beams built into a false ceiling, Fläkt Woods recommends a free area in the false ceiling of min. 0.1 m^2 per linear metre of the beam and a free distance of 100 mm between the ceiling and the top edge of the beam for wide beams, see Figure 4.1, and 75 mm for narrow beams, see Figure 4.2.

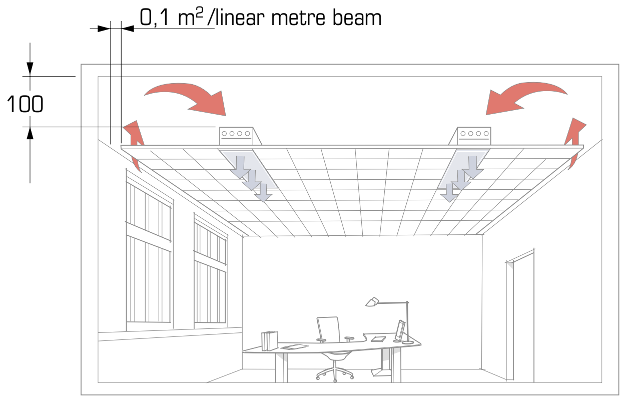


Fig 4.1 Wide passive beam in a false ceiling

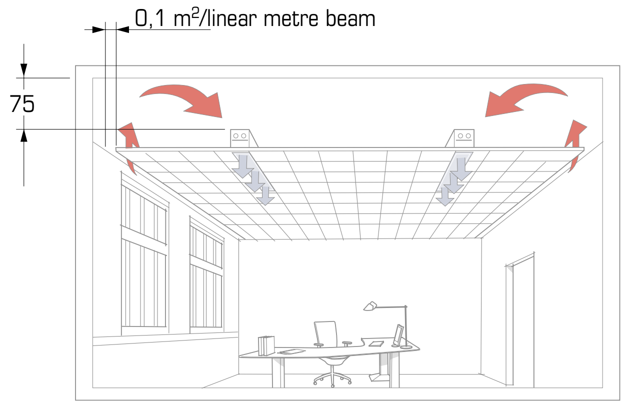


Fig 4.2 Narrow passive beam in a false ceiling

System and project design

Temperature gradient in the room

In actual installations, heat sources with a high convection flow can give rise to a difference between incoming circulation air temperature to the chilled beam coil and the room air temperature at 1.1 m above the floor. The temperature at a point 1.1 m above the floor is defined as the room temperature. In those cases in which the temperature at the beam is higher than the 1.1 m level, the higher temperature must be used for calculating the temperature difference between the air and mean water temperature (Δt). A higher value for Δt will increase the cooling effect emitted from the beam coil. The temperature at the beam is referred to as the ceiling temperature.

As a rule of thumb, a temperature difference of 0.5 – 1 ºC between the air at the beam and at the 1.1 m level applies for supply air beams. A value of 1 – 2 ºC applies for passive beams.

Beams above a perforated (smooth) false ceiling

The requirement exists in certain cases for the chilled beams to be concealed above a perforated false ceiling.

Full-scale tests indicate that Fläkt Woods chilled beams for freely suspended installation (IQFC) give the best results in terms of both capacity and flow in the room.

In order to retain the full cooling effect from the beam, the false ceiling must have at least 35 % free area, and the distance between the false ceiling and the beam should be at least 100 mm. The outflow from the IQFC beam is inclined upwards, and this causes the air to have a lower velocity when it meets the false ceiling. The result is a gentle influx into the room without draught problems.

Passive beams must be installed at least 100 mm above the false ceiling, which in this case must also have a free area of at least 35 %. The cooled air from the beam will flow out when it meets the false ceiling and will flow into the room through an area that is up to 3 times larger than normal. The flow into the occupied zone of the room will be more gentle with a false ceiling.

The room air that must pass upwards through the false ceiling must not be disturbed by the air flowing downwards from the passive beams and should have an equally large false ceiling area at its disposal.

It is possible to apply a rule of thumb that the minimum c/c distance between the beams must be:

$$c/c = 2 \times \text{beam width} \times \frac{100}{\text{Free area false ceiling \%}}$$

i.e. a 50 % free area for the false ceiling and a beam width of 430 mm gives

$$c/c = 2 \times 430 \times \frac{100}{50} = 1720 \text{ mm}$$

Supply air ducts

Experience shows that one balancing damper per beam is most common, and that the air flow is measured with the pressure outlet on the beam. This is a good solution where high flexibility is required, because the flow can be changed easily as the demand changes.

The pressure drop over the beams is normally 50 - 70 Pa. This means that up to 10 beams can be supplied with off-shoots from a main duct with maximum flow deviation of ±5 % with normal air velocities in the ducts. This makes it possible to use a measurement and adjustment device (e.g. an iris damper) for several beams. This is appropriate in the case of lower requirements for flexibility.

With Fläkt Woods IQ beams with comfort control, there is no longer a need for a damper for every beam because the damper function is present in the design of the beam.

This gives both high flexibility and the opportunity to select the cheaper solution with a single damper in the duct for several beams.

European standard for testing of chilled beams

EU cooperation has led to standardized test methods, which must be used by manufacturers in the EU.
EN 14518 applies to passive chilled beams, and prEN 15116 applies to supply air beams (active beams).

Because the heat output to the room, i.e. the surplus heat which the beam is to remove by cooling, is distributed uniformly over the walls and floor, the temperature conditions in the room air are very stable and the same test results are obtained regardless of the laboratory. The test methods give the room air a negligible temperature gradient in the vertical sense.

Cooling

The cooling effect from a beam depends on the temperature difference between the room temperature and the mean temperature of the water in the coil and the supply air flow.

It is necessary to avoid condensation precipitation in the coil and on the incoming pipe. Experience has shown that an incoming water temperature of 14° C is appropriate.

System and project design

Heating

Heating of the room takes place with a radiator or heating loop in the beam. A radiator gives the smallest temperature differences between floor and ceiling.

The coil in the beam can be provided with an extra pipe loop for heating water, which can give high heat output with a normal feed temperature for the water.

Precisely as in the case of a ceiling diffuser, the beams are dimensioned for a suitable air movement in the room in the cooling mode. In the case of supply air at an excessively high temperature (as in heating mode), the through-ventilation of the room will reduce slightly compared with the cooling mode, and the temperature difference between the floor and the ceiling will increase.

Product selection program, WinDon

The WinDon program is available on the Fläkt Woods web site.

Taking the room and its loadings and the requirement for the chilled beams as its starting point, WinDon makes suggestions for different beams that are capable of meeting the set requirements. The result is presented in a list with current technical data such as the cooling effect, air flow, air pressure drop, hole length, noise generation, water flow and water pressure drop.

The program also has the ability to draw envelopes for the flow in the room (in plan view and sections) with one or more chilled beams. The program also takes account of the fact that the air flow can be different on both sides of the beams, and that the distribution depends on the settings on FPC. The result for a number of different beams can be compared in a rapid and flexible manner. This provides a good basis for decisions.

Input data, codes and technical data are presented in the output list, as well as a drawn section with envelopes. This can be used as a valuable document for the quality assurance of the project design, because the input data document the conditions in the form of thermal loadings, etc.

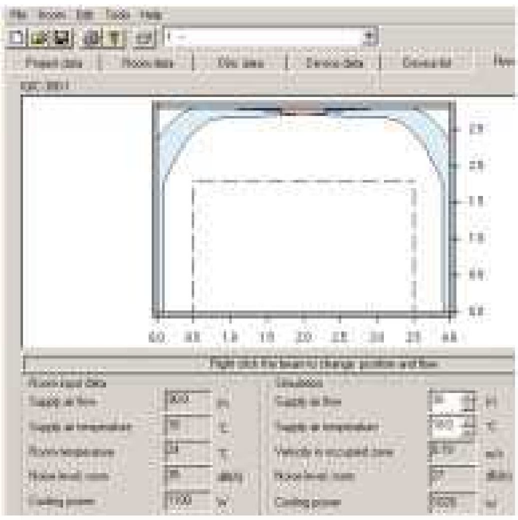


Fig. 5

Beams with lighting

Lighting can be integrated into certain chilled beams. An advantage of this is that ceiling area is freed up by the fact that several functions are collected together in the chilled beam. This means that the installation proceeds more quickly and the installation costs are reduced because fewer products must be installed.

In order to achieve the best lighting and ventilation solution for the room, cooperation between a ventilation consultant and a lighting consultant is desirable, since ventilation and lighting are two separate ”sciences”.

The simplest case is indirect lighting, when the light from the fittings must be aimed up towards the ceiling and reflected diffusely down into the room. The result must be general ”lead lighting”. It is necessary to provide a sufficient distance from the top edge of the beam to the ceiling in order for the diffusion of the light to be adequate. In other respects, the ventilation requirement can control the position of the beam.
Fläkt Woods freely suspended IQFC beam is available with direct lighting.

The coordination requirements for direct lighting are greater.
There are requirements both for a given lighting intensity, for example on a work surface, and for the air from the beam to ventilate the occupied zone well without causing draught problems.
In the majority of cases, it is acceptable to combine these techniques, although in other cases there are conflicting interests, and a different solution must be selected.
The bottom plate in the Fläkt Woods IQID and QPDA beam can be provided with fittings for direct lighting.

Multifunctional chilled beam

In certain positions, there is a need for a beam which includes functions that are otherwise installed separately in the room. The phenomenon is referred to as a multifunctional chilled beam.
Fläkt Woods IQID chilled beam is a multifunctional chilled beam which, when fully equipped, can include the following functions:

Supply air
Cooling and heating
Comfort control (adjustable hole length for the supply air)
FPC (Flow Pattern Control)
Increased air flow
Control & regulation equipment
Lighting
Prepared for sprinkler

System and project design

Pipe system

Heat transfer medium system

A heat transfer medium system has a main circuit, in accordance with Figure 6, which includes a main pump, expansion vessel, and accumulator tank if required, etc. It is in this main circuit that cooling of the water takes place in the evaporator of a refrigerating machine or on the secondary side of a heat exchanger.

Connected to the main circuit are consumers of various kinds, secondary circuits, see details 6.2, which contain cooling coils in air treatment units and chilled beams. From the control point of view, the main circuit is a system and every connected consumer is a discrete system.

The main circuit always includes a means for controlling the heat transfer medium temperature and, in certain cases, also a means for controlling the pressure and thus the flow.

Controlling of the heat output takes place with two-way or three-way valves, see details 6.3.
Secondary circuits can be controlled by a temperature in a room, a duct or in a pipe.

When a two-way valve moves towards the closed position, the pressure drop is increased and the flow is reduced. When installed in accordance with Figure 7.1, the flow will vary in both circuits. When installed in accordance with Figure 7.2, the flow can be kept constant in the secondary circuit, whereas it will vary in the main circuit.

A three-way valve in accordance with Figure 8 can be installed as a mixing valve (two inlets and one outlet, Figure 8.1) or distribution valve (one inlet and two outlets, Figure 8.2).

It is normally set as a mixing valve. The outlet port has a constant flow, whereas it varies in the inlet ports. When installed in accordance with Figure 8.3, the flow through the secondary circuit will vary while the flow in the main circuit remains constant. When installed in accordance with Figure 8.4, the flow remains constant in both circuits.

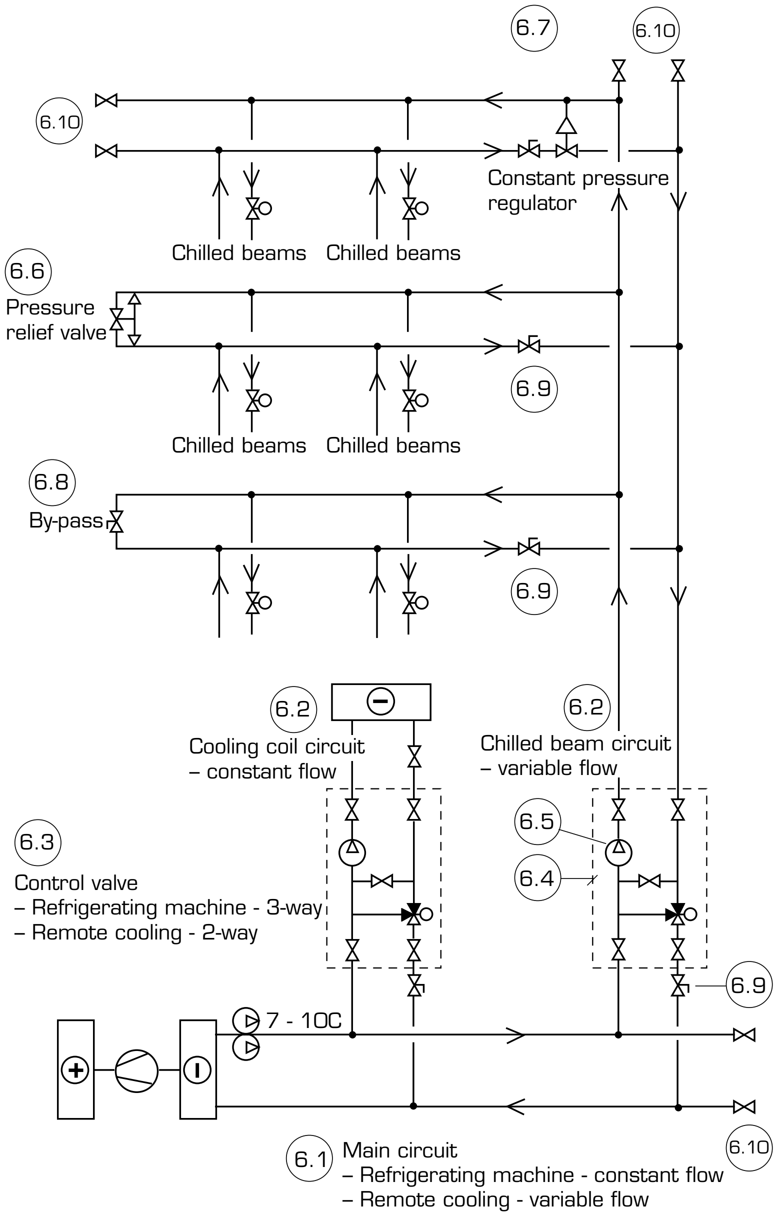


Fig 6. Outline drawing for a heat transfer medium system.

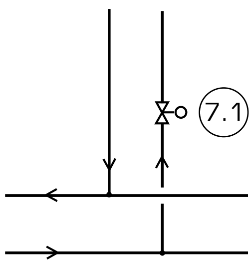


Fig. 7.1

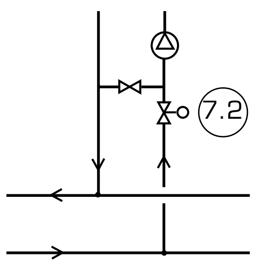


Fig. 7.2

System and project design

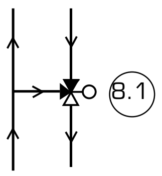


Fig. 8.1 Mixing valve

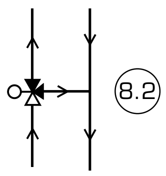


Fig. 8.2 Distribution valve

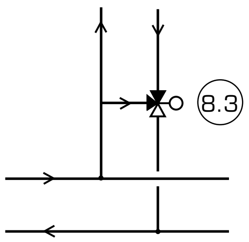


Fig. 8.3

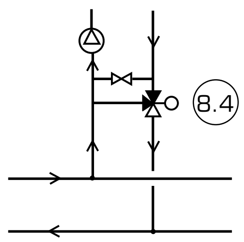


Fig. 8.4

Constant flow requires:

- a pump with constant speed of rotation
- 3-way valves in the system

Constant flow is normally selected in the main circuit if the installation contains its own refrigerating machine in view of the risk of freezing in the evaporator if the flow is too low.

Variable flow requires:

- A pump with speed regulation, as a rule pressure controlled
- or a pump with a flat pump curve and sufficiently low pressure at the dammed point, i.e. at zero fl
- 2-way valves in the system

In systems that are connected to a remote cooling network, two-way valves are normally required.

Secondary system

The main circuit normally operates at a feed temperature of 7 - 10° C. Chilled beams cannot be supplied with water colder than 14 - 15° C due to the risk of condensation. A shunt group, see Figure 6 detail 6.4, which mixes heated return water with cooled feed water to a constant temperature, is installed for this reason.

The control valves that are used for chilled beams are two-way valves with a thermomotor. The flow of the heat transfer medium in the secondary circuit will vary accordingly.

Noise

A heat transfer medium system is not normally under load during the night. In the morning all valves are closed, i.e. the flow in the circuit is zero. The pump works at the dammed point. When the loading increases (lighting is switched on, computers are turned on, personnel arrive), the valves begin to open.

If the pressure over the valves is higher than circa 30 kPa when they begin to open, they will generate noise. To avoid noise problems, one of the measures listed below may be adopted.

Pressure-controlled pump

The pump can be pressure controlled so that the speed of rotation of the pump reduces as the flow reduces, see Figure 5 detail 5.5. The cheapest and simplest option is a pump with a built-in frequency changer.
This automatically controls the pressure set-up of the pump, either at a constant value, or according to a curve, which attempts to take account of the friction pressure drop in the lines.

Limited pressure at the dammed point

As an alternative to a pressure-controlled pump, it is possible to select a pump which, when the flow has dropped to zero, produces slightly less than 30 kPa. No valve in the system is then subjected to a higher pressure than 30 kPa, and noise problems are avoided. This solution can only be selected in systems that are sufficiently small to be able to manage with a small pump.

Pressure relief

A third possibility is to install a so-called pressure relief valve at the end of the system, see Figure 6 detail 6.6. When the pressure at the relief valve reaches a preset value (max. 30 kPa) a valve opens and connects the feed and return line. This ensures that the pump never goes towards the dammed point.

Constant pressure regulator

A constant pressure regulator, Figure 6 detail 6.7, measures the differential pressure between the feed and return line and keeps this constant by throttling out any ”surplus pressure”.

The regulator is self-acting. The large heat transfer medium system can be divided up into suitable groups, which are provided with a constant pressure regulator in order to restrict the pressure over the control valves.

Time delay

In a circuit with closed two-way valves, the water is entirely stationary. When the first valve begins to open, its chilled beam receives water that has remained stationary in the pipes and has become heated. It can take a considerable time in a large system before cooled water begins to emerge.

By short-circuiting the feed and return at the furthest point in the circuit with a by-pass line, see Figure 6 detail 6.8, via a control valve, it is possible to ensure that the circulation never ceases and accordingly that cooled water is always available.

System and project design

Venting

Every pipe system for heating or cooling must be vented. The systems are provided with central venting means, which continuously and automatically removes any air bubbles from the water during operation. Heat transfer medium systems are more difficult to vent than heating medium systems, due to the fact that the air is released more easily when it is warm. It is more important, therefore, for a heat transfer medium system to be designed with venting in mind than corresponding heating systems.

When a system is filled with water, the pump is stationary. Air will become trapped at all high points in the system.

All such high points are provided with a venting valve for this reason. In order to minimize the number of venting valves, the pipe system is designed so that it is ”strongly falling” from one venting point, that is to say ”strongly rising” from the chilled beams, so that the chilled beams are low points.

Connected heat transfer medium pipes must be attached to downward projections on (that is to say the underside of) the side lines.

The side lines are connected in turn to downward projections for main lines, etc.

A venting valve is installed where departures from the above principles are necessary, and where high points are present.

Adjustment

Heat transfer medium systems must be provided with the facility for measuring and adjusting the flow. Control valves with measurement sockets are installed in main and branch lines, see Figure 6 detail 6.9. It is also desirable for every beam to be provided with a control valve and measurement socket, see Figure 9, detail 9.1, even if it is customary to select valves without a measurement socket. These are set in accordance with calculated values in this case.

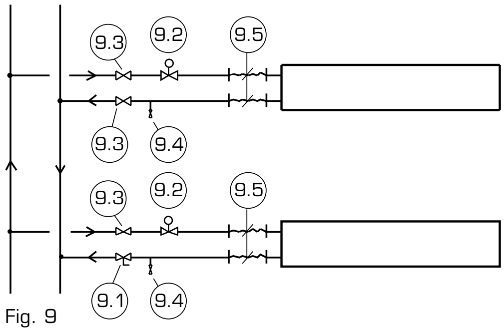


Fig. 9

Flushing

The valves for chilled beams control relatively small liquid flows. The throughput in a valve is very small. The systems are accordingly sensitive to particles of dirt in the water.
It is sensible to provide the pipe lines with steps which permit flushing, see Figure 6 details 6.10 on page 11.

Insulation

Pipes for cold mediums must be provided with diffusion-tight insulation to prevent condensation. The most common insulation on heat transfer medium lines is cellular rubber.

Both the feed and the return line should be insulated. It is true that the return line is normally so hot that the risk of condensation is not present, although as a result of an accident during operation, or as a result of failure of the control equipment, it is possible for the temperature to fall below the dew point with condensation precipitation as a consequence. Excessively large energy losses in the lines are also not permitted in accordance with the building regulations of the National Swedish Board of Building, Planning and Housing (Boverkets Byggregler, BBR).

Valves

Valve coupling

Every chilled beam must be capable of being switched off, adjusted and very often controlled as well. A coupling of the valves which provides these functions is installed on every beam. The control valve can have an adjustable kvs value, which means that the water flow can be adjusted with the help of the control valve.
The coupling in this case consists of two cut-off valves, see detail 9.3, and one control valve, see detail 9.2. The control valve is installed in the inlet. If the control valve has a fixed kvs value, one control valve is installed for the adjustment, see Figure 9 detail 9.1. This can be shut off and replaces the single cut-off valve.

The coupling thus consists of one cut-off valve in the inlet, detail 9.3, one control valve in the return, detail 9.1, and one control valve in the inlet, detail 9.2.

The cut-off valve in the inlet, see Figure 9, detail 9.3, may selected with advantage as a type which contains a small strainer in the ball. The strainer protects the regulation and control valves against any contamination that may be present in the water.

If the chilled beam constitutes a high point in the system, the coupling is also provided with a venting valve in the return line in accordance with Figure 9, detail 9.4.

Hose connection

In order to permit adjustment of the beam in the vertical and lateral directions, it may be practical to connect it with a hose in accordance with Figure 9, detail 9.5. Hoses offer a greater flow resistance than pipes, and it may thus be appropriate to select hoses with a dimension that is larger than the pipe.

Control valve

The chilled beam capacity is adapted to the demand by varying the water flow through the beam. The pressure drop over the valve must be at least as large as that over the beam, although it must not exceed 30 kPa.

System and project design

One valve per beam

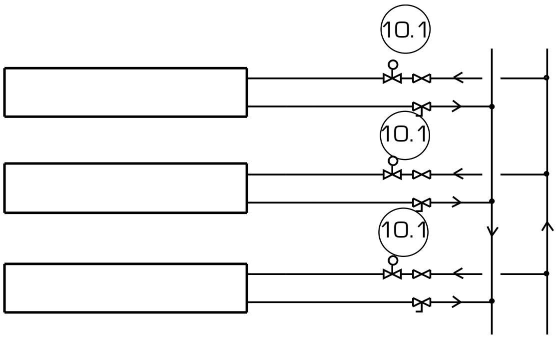


Fig. 10.1

The greatest flexibility is provided with one valve per beam, in accordance with Figure 10.1. One control unit can control one or more beams. In a future rebuilding, only electric switching will be required between the control units.

The principle is applicable to offices with heat transfer medium pipes in a corridor and a cell office or a future cell office along a façade with subdivision into modules.

Fläkt Woods offers regulators with the ability to control nine (9) valves each on the cooling and heating side. By building a system with slave regulators, up to 30 cooling valves and 30 heating valves can be actuated from a single regulator.

Common valve for multiple beams

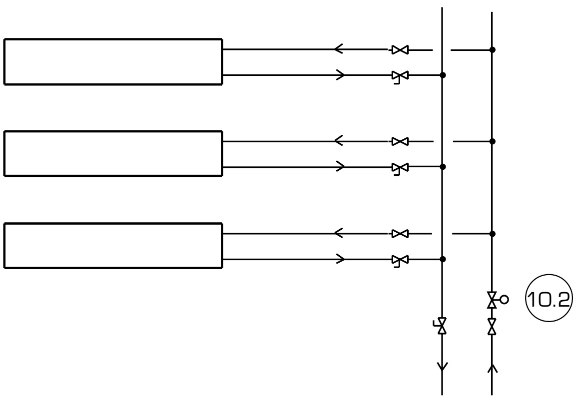


Fig. 10.2

Multiple chilled beams can be connected together to a common control valve in accordance with Figure 10.2.

Changes in regulation zones require reconstruction of the pipe system, and the method is used when there is no requirement for flexibility. For example, these can be large offices, retail premises, schools, etc.

Cost comparison

Choice between a common valve for multiple beams or a single valve for each beam?

The control valves and actuators that are used for a single beam are comparatively simple and inexpensive, whereas the larger valves that are required to control multiple beams jointly are of a different and more expensive type.

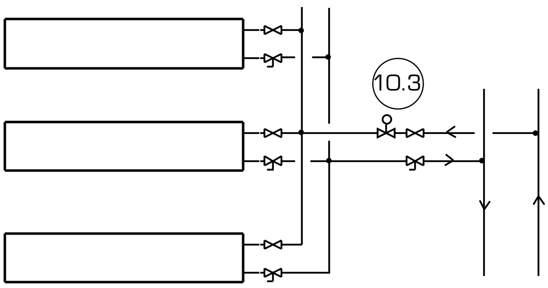


Fig. 10.3

In order to connect multiple beams to a common control valve, it may be necessary to lay additional piping in accordance with Figure 10.3.

It is often found in systems of the cell office type along corridors that it is not more expensive to have one control valve per beam, and flexibility is achieved in addition.

Control system

Heating and cooling

In rooms with a requirement for both heating and cooling, it is appropriate from an energy point of view to install a control system which prevents heating and cooling from operating simultaneously. Heating can take place either with radiators or with a heating loop in the chilled beam.

Both the heater and the cooling coil of the beam can be provided with a control valve. The valves are controlled in sequence from a common control unit, i.e. so that the heating valve closes before the cooling valve opens. A neutral zone is often placed in addition between the heating and cooling, where both valves are closed in a particular temperature interval, see Figure 11.

Cold downdraught

In modern buildings with efficient and not excessively large windows, it is advisable to use sequential control with a neutral zone.

If, on the other hand, the windows are large and/or inefficient, sequential control can give rise to cold downdraught problems, because the radiator is turned off as soon as the need for cooling arises. There are long periods when the radiator is turned off at the same time as the window is cold. A number of different methods are available for countering this problem:

1) The control valve for the radiator is provided with leakage, so that it is never fully closed, see Figure 11, detail 11.2.

System and project design

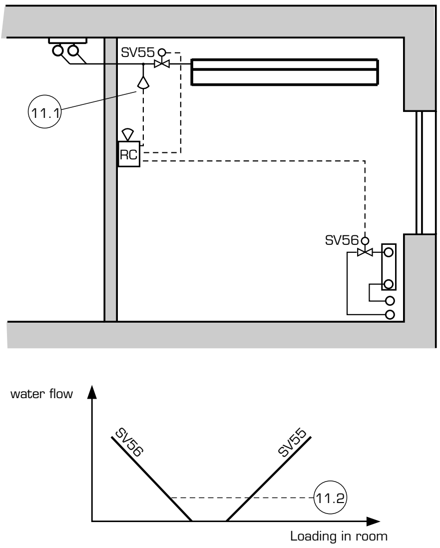


Fig. 11

2) The radiator can serve as a pure means of cold downdraught protection by the feed water temperature being controlled exclusively with reference to the outdoor temperature. The radiator is provided with a manual valve, and the feed temperature is controlled according to a curve by the outdoor temperature.

Condensation

In order to achieve the greatest cooling effect possible from the chilled beams, the lowest possible temperature must be selected for the heat transfer medium.
The downward limit is represented by the risk of condensation precipitation, which occurs in that part of the heat transfer medium system in which the surface temperature is lower than the dew point of the surrounding air. A heat transfer medium temperature of 14° C is sufficiently high to avoid condensation under normal conditions. Days can occur, however, very often in August, with such high atmospheric humidity that the precipitation of condensation occurs at 14° C.
To avoid condensation problems, one of the following measures can be adopted:

Condensation sensor on incoming pipes to the chilled beam

A sensor can be connected to the control unit which controls the cooling valve of the beam, see detail 11.1, which is attached to the incoming heat transfer medium pipe in the chilled beam. When the sensor registers the risk of condensation on the pipe, i.e. when the relative humidity is over 90%, the control valve is closed, as a consequence of which the surface temperature on the incoming pipe and coil increases and condensation precipitation is avoided.

Advantage: Cooling does not take place only in those rooms that have condensation precipitation.

Disadvantage: The room receives no cooling.

Increase in heat transfer medium temperature

The atmospheric humidity is measured with a sensor for relative humidity (GM) together with a sensor for the temperature of the air (GT2). The water content of the air, and with it the dew point, are determined, and the heat transfer medium temperature reference value (GT1) is

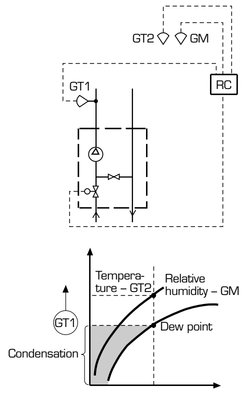


Fig. 12

displaced upwards in accordance with a curve so that condensation precipitation is avoided, see Figure 12 below.

Depending on the application, the atmospheric humidity can be measured outdoors or indoors. Measurement indoors, e.g. in the exhaust air, is carried out when it is possible to be certain that doors and windows are kept closed so that the heat transfer medium system does not come into contact with outdoor air. In installations in which windows and doors can be expected to be open often, measurement should be carried out outdoors.

Advantage: General measure which avoids the risk of condensation in the entire building at the same time.

Disadvantage: The cooling effect reduces in the entire building, i.e. including any computer rooms where it may be important to provide the full cooling effect. This does not apply, however, during a very short period.

Dehumidification

In buildings where windows and doors are normally kept closed, the risk of condensation can be prevented by dehumidifying the supply air.
To cope with dehumidification on a regular basis, a heating coil is required after the cooling coil in order to ensure that the air does not become too cold.

In order to avoid condensation during individual days with extreme atmospheric humidity, extra cooling of the supply air can be utilized for dehumidification without reheating.

Advantage: Full cooling capacity is retained.

Disadvantage: Premises with low thermal load, e.g. unused conference rooms in the core of the building, can be cooled completely.

System and project design

Installation

Freely suspended

Freely suspended beams are installed with hangers.

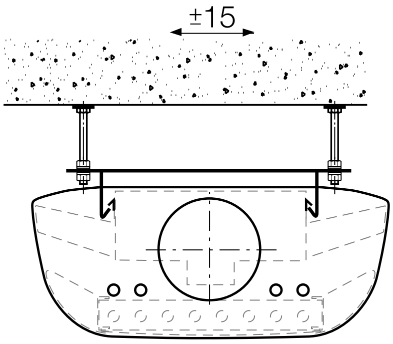


Fig 13. Installation of freely suspended chilled beams.

Where the appearance of the installation is subject to strict requirements, it is advisable to select a beam with an extended casing on the connection side or a cladding for ducts and pipes which covers the distance from the beam to the wall.

Where none of these alternatives is used, it is inappropriate to have a hose connection on the air side, and any damper and sound attenuator should be positioned if possible in the false ceiling of the corridor.

It must be possible to paint the insulation, of the Armaflex type, on the pipe side. The valve coupling should be positioned if possible in the false ceiling of the corridor.

Recessed in false ceiling

Beams that are to be installed recessed in a false ceiling, can be installed with hangers or directly in the load-carrying structure of the false ceiling.

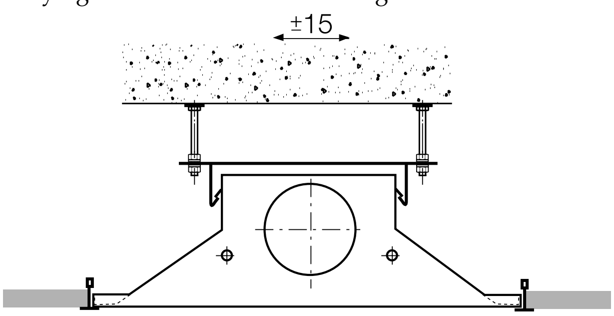


Fig 14 Installation of beam in a false ceiling with hangers

The installation procedure is as follows:
1. Suspend the beams and roughly adjust their position.
2. Install the load-carrying structure for the false ceiling.
3. Adapt the beams as required to the load-carrying structure.
The method means that, as a rule, two operations are needed to get the beams in place.

It is important for the beam and installation fittings to permit adjustment of the position of the beam in the vertical, lateral and longitudinal directions.

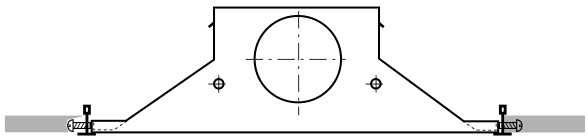


Fig 15. Installation of beam directly in the false ceiling

The beams can be laid on the load-carrying structure of the false ceiling. The suspension rods of the load-carrying structure are dimensioned so that they are also able to support the chilled beams, which very often means that there will be some extra suspension rods.

The installation procedure is as follows:
1. Install the load-carrying structure.
2. Position the chilled beams.
3. Secure the beam with screws through the T-profiles of the load-carrying structure.

This method means that, as a rule, a single operation will be sufficient to get the beams in place.

Connection to pipe system

Regardless of the way in which the beams are installed, it is easier of they are connected with hoses. In the case of suspended installation, readjustment will often be required. In both cases, the hose means that installation of the pipework with its off-shoots can be undertaken as a single operation, which is independent of the beam installation. The length of the hose must be adapted to the demand so that unnecessary and transverse curves are avoided.

Connection to supply air duct

In the same way as for the pipe connection, assembly is simplified if the beams are connected to the duct with a flexible hose.

The hose must be fully extended, and transverse curves must be avoided to ensure that unpredictable pressure drops and noise sources do not occur.

Connection of chilled beams in series

It is most usual for beams in the same room to be connected in parallel on the air and water side. It is also possible, however, for two beams to be connected in series. The first beam in the air direction has a special execution in this case. The air needs to pass out through the far end wall (viewed in the air direction) and into the next beam.

Similarly, the coil in beam number one is adapted to allow the water to continue into the next beam. It is necessary to indicate clearly in the description that two beams must be connected in series. No more than two beams must be connected in series, in particular having regard for the pressure drop on the water side.

Care

The coil must be accessible for cleaning. This applies in particular to the side of the coil that is ”hit” by the circulating room air.

For Fläkt Woods IQ supply air beams, the room air is admitted into the coil from below. The under side is readily accessible for cleaning by hinging down the bottom plate or sliding it out of the way.

For passive beams, the upper surface of the coil must be vacuum cleaned.

If the beam is built into a false ceiling, a number of false ceiling panels must first be removed.

Experience indicates that the cleaning interval for batteries is 5 - 10 years.

The supply air duct in the IQ beams is prepared for cleaning through removable covers, which are accessible after the bottom plate has been hinged down or slid out of the way. With a good fine filter in the supply air unit, this will need to take place at intervals of circa 10 years.

Designations and names used for system parts

Primary and secondary circuit:

In remote cooling systems, the primary side denotes the energy supplier’s side of the heat exchanger and secondary side denotes the building owner’s side.
In systems with their own refrigerating machine, the main circuit, i.e. the circuit in which the refrigerating machine is situated, can also be referred to as the primary circuit.

Every shunt group can also be said to have a primary and a secondary side, where the primary side is the side that is connected to the supply, and the secondary side is the side that is connected to the consumer.

Main circuit

Denotes the circuit which contains the main pump.

Main line

Denotes the line in the main circuit or a larger mains supply to a building or part of a building.

Side line

Denotes a vertical line in a shaft or pipe slot (analogy with the stem of a tree).

Branch line

Denotes off-shoots from a main stem out onto a floor level, for example (by analogy with a branch on a tree).

Components

SV Control valve
Valve with actuator for automatic control

RV Control valve
Valve for adjustment

AV Cut-off valve
Valve for cutting off

AL Venting valve
Valve for venting