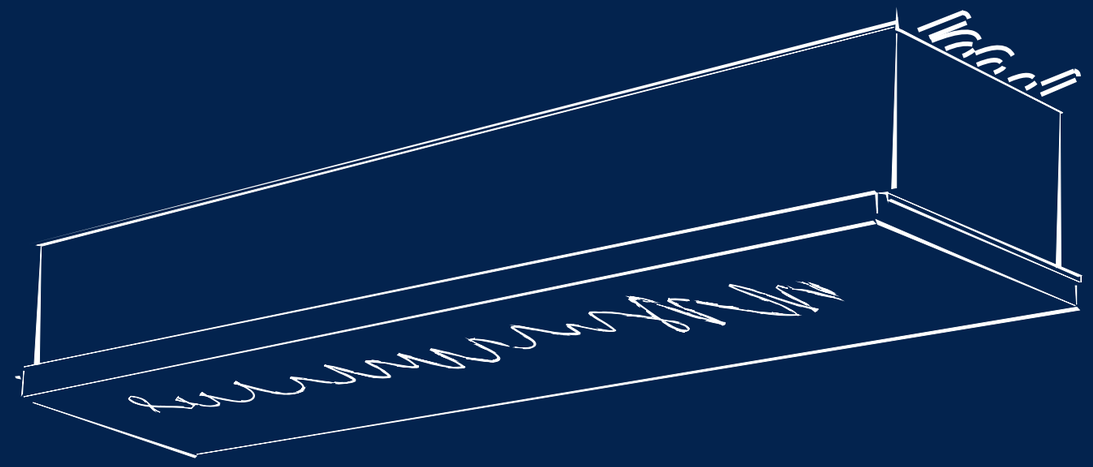
BARCOL-AIR



AIRFIT - P Series

Website: www.barcolair.net

BARCOL-AIR

Index

Introduction

The Barcol-Air Airfit P passive chilled beam systems are designed to achieve effective cooling at the lowest energy cost. They operate using chilled water and are suitable for air-conditioning offices and many other applications where low operating costs are important. The system provides cooling, ventilation and humidity control with minimal noise and with almost no maintenance. Heating can also be made available with a separate perimeter heating system.

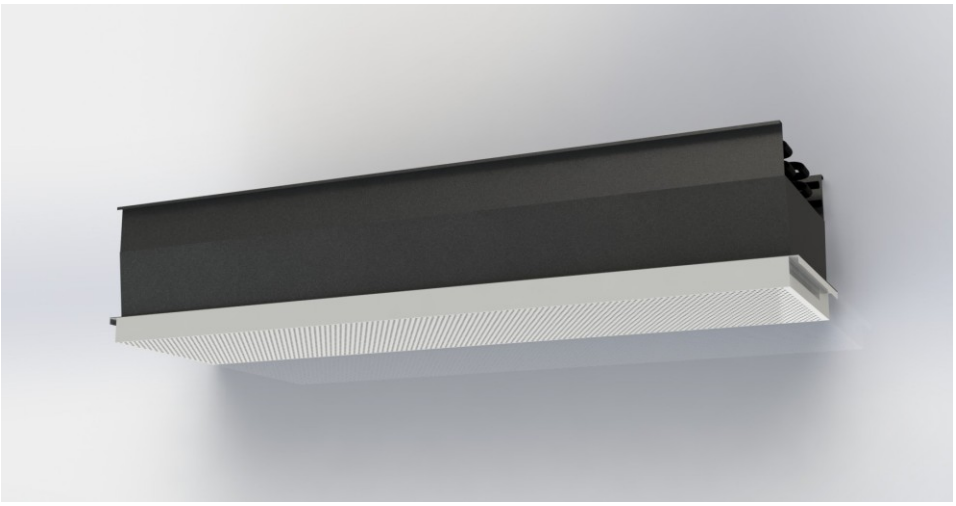


Figure 1: Barcol-Air Airfit P Passive Chilled Beam

System Concept

The principle of the passive chilled beam system is to use terminal chilled water heat exchangers in the ceiling to offset the room sensible cooling loads. The ventilation and humidity control requirements are taken care of using a separate system of primary conditioned air supplied by a central air handling unit.

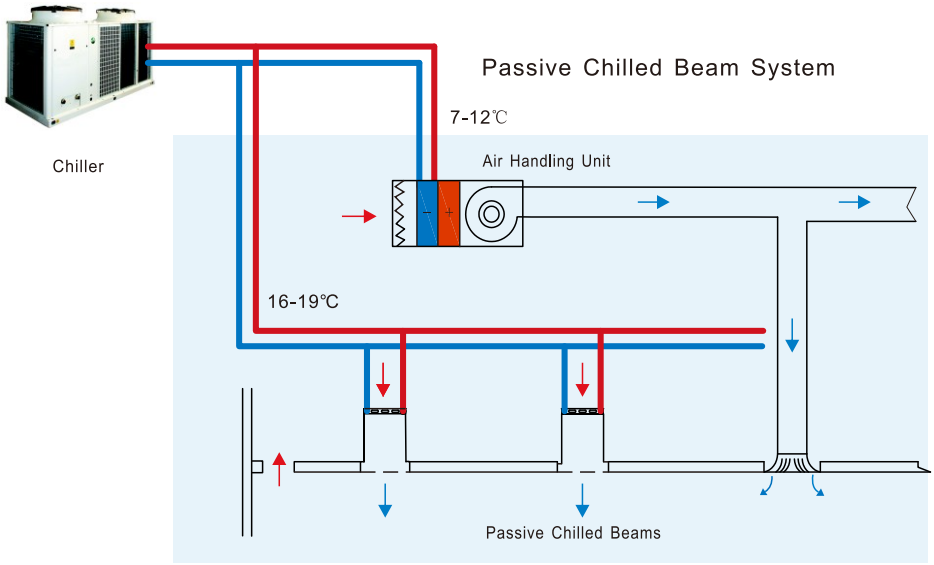
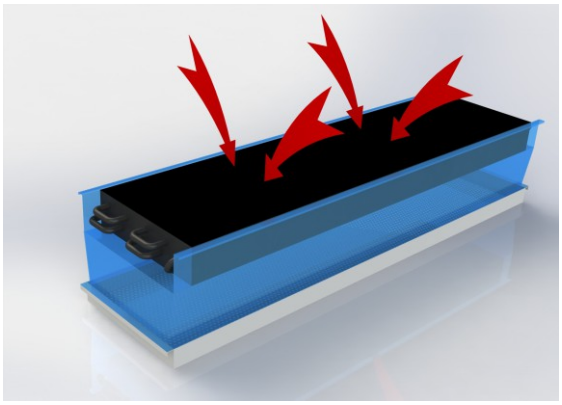


Figure 2: Passive Chilled Beam System

System Concept

Cooling from the passive chilled beam is achieved by natural convection. The air surrounding the heat exchanger is cooled as it comes into contact with the heat exchanger and as its temperature reduces the density of the air increases resulting in a downward air flow pattern. This happens without the need for any external energy force to move the air resulting in large energy savings which are the main benefit of the system.



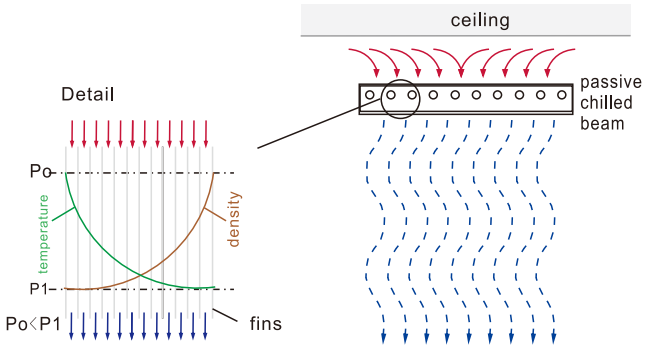


Figure 3: Passive Chilled Beam Natural Convection

Also as the separate primary air system is required only for ventilation and humidity control the amount of air can be reduced substantially verses conventional all air systems, and often the primary air can be reduced to only that required for ventilation allowing the use of 100% fresh air without the need for air recirculation. This provides further energy savings as well as excellent indoor air quality.

The primary air system is designed to maintain the room humidity level above the dew point temperature of the chilled beam so that the heat exchanger operates without condensation. This avoids many of the maintenance and health concerns associated with other terminal heat exchanger systems such as fan coil systems that require condensate removal systems and are susceptible to algae growth and other forms of contamination, as well as blocked drains and leaks.

To avoid the possibility of condensation on the passive chilled beams the primary air should be pretreated in a central air handling unit so that it can maintain the room dew point temperature at about 2 degrees C below the entering chilled water temperature, which is typically 16 deg C. In addition the building ventilation system should be controlled to maintain a small positive pressure in the building so that any air infiltration is out of and not into the building. In this way even if a window is left open the air flow should be out of the building, avoiding loss of control of the internal humidity level. For further protection condensation sensors can be installed on the entering chilled water piping for each operating zone that will close the chilled water supply or reset the chilled water temperature to a higher level, if it is sensed that the dew point of the air surrounding the chilled water piping is approaching saturation.

Application Considerations

Air distribution in the room

Because passive chilled beams operate using natural convection the cooled air flows downwards from the unit. It is therefore important to locate the units carefully in order to avoid down drafts above the room occupants. Passive chilled beams are best sited above unoccupied areas and typically are installed adjacent to the perimeter walls or corridor walls.

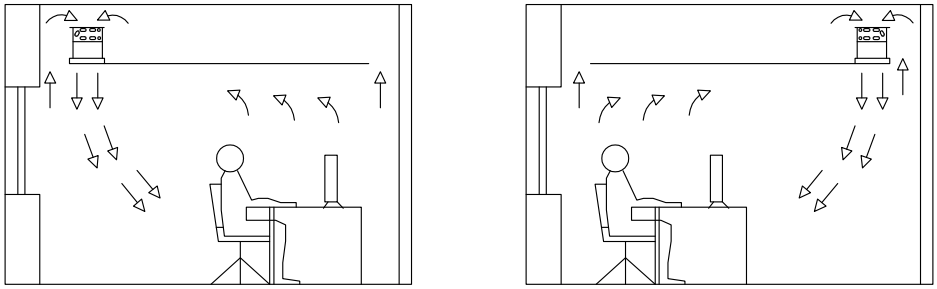


Figure 4: Positioning passive chilled beams

Return Air

To provide an air path for the room air to return into the ceiling void and back to the chilled beam it is normal to install perforated ceiling panels or to leave a gap around the perimeter of the false ceiling. This avoids obstructions to the return air flow which can reduce the cooling capacity of the passive chilled beams.

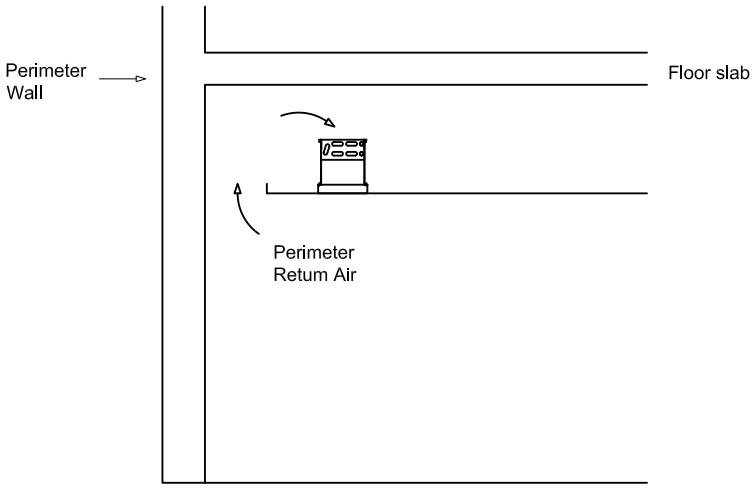


Figure 5: Air path for return air

Application Considerations

Chilled Beam Skirt

The performance of the passive chilled beam is enhanced by the provision of a skirt below the heat exchanger. This improves the natural convection of the air through the unit. Different skirt heights are available to match the requirement of cooling performance and available ceiling void height.

Free space above the chilled beam

It is necessary to ensure adequate free space between the top of the chilled beam and the floor slab above to ensure good airflow into the unit. This is distance H1 in the diagram below.

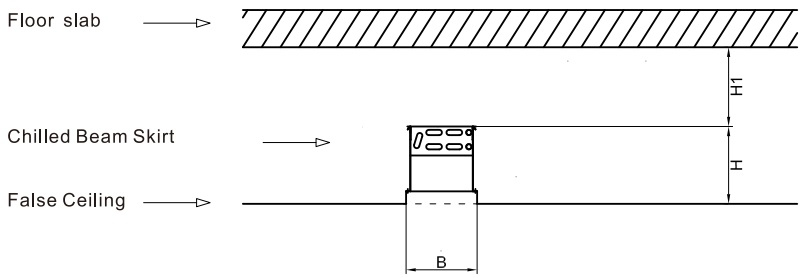


Figure 6: Free space above the chilled beam

Where there is free air flow to both sides of the unit, H1 should not be less than 25% of the unit width B. If the chilled beam is located adjacent to a wall, within a distance of B or less, then H1 should not be less than 50% of B.

Free area below chilled beam

Barcol-Air Airfit-P passive chilled beams can be supplied with or without an air diffuser. We offer as an option a perforated diffuser with a free area designed to match the required unit performance. Other configurations including linear, metal mesh and egg crate diffusers can be supplied.

Product Presentation

Configuration Choices

Barcol-Air Airfit-P passive chilled beams are available in a variety of configurations to match the meet the specific needs of different projects:

- Unit heights of 120, 200 and 300mm including the chilled beam skirt to match different performance and available space needs.
- With or without outlet diffusers. Our standard diffuser option is a perforated type but other diffusers can be made available including linear, metal mesh and egg crate configurations.

Different Sizes and Capacities

Our passive chilled beams are available in different widths – nominally 300mm and 600mm as standard to match with most ceiling systems. Different lengths are available in increments of 300mm from 1,200mm to 3,000mm or special lengths can be made available match particular project requirements.

Simple Mounting

The units are designed to be suspended from the ceiling slab and are supplied with support brackets for threaded rod or cable suspension.

Controls

The cooling capacity of the Airfit-P passive chilled beams is controlled using a chilled water control valve connected with a room thermostat. It is also recommended to install condensation sensors on the supply chilled water piping to each zone to close the chilled water supply or increase its temperature, if the surrounding air dew point temperature approaches the temperature of the chilled water inlet pipe.

Silent Operation

The air movement though the unit is by natural convection and therefore the operation of the units is completely silent.

Hygienic Operation

The cooling coil in the unit operates dry and therefore there is no need for condensate drain pans in the units and condensate drainage pipe work. This eliminates the health risks due to algae growth in drain pans and the smells and problems which can arise from stagnant condensate in drain pans and drain pipes.

Ventilation Humidity and Air Quality Control

Ventilation, humidity and air quality control is provided by the primary air supplied by a central air handling unit (AHU). The AHU ensures that the incoming air is dehumidified to control the room humidity for comfort conditions and to eliminate the possibility of any condensation on the chilled beam coils. The AHU should also include high efficiency air filters to control the room air quality and will normally use 100% fresh air, eliminating the need for air recirculation.

Low Maintenance

With the elimination of air fans and motors, air filters and condensate pans and drains there is almost no maintenance required for the chilled beams. Only the coil requires vacuum cleaning occasionally to remove dust, typically every 2 to 5 years.

Dimensions

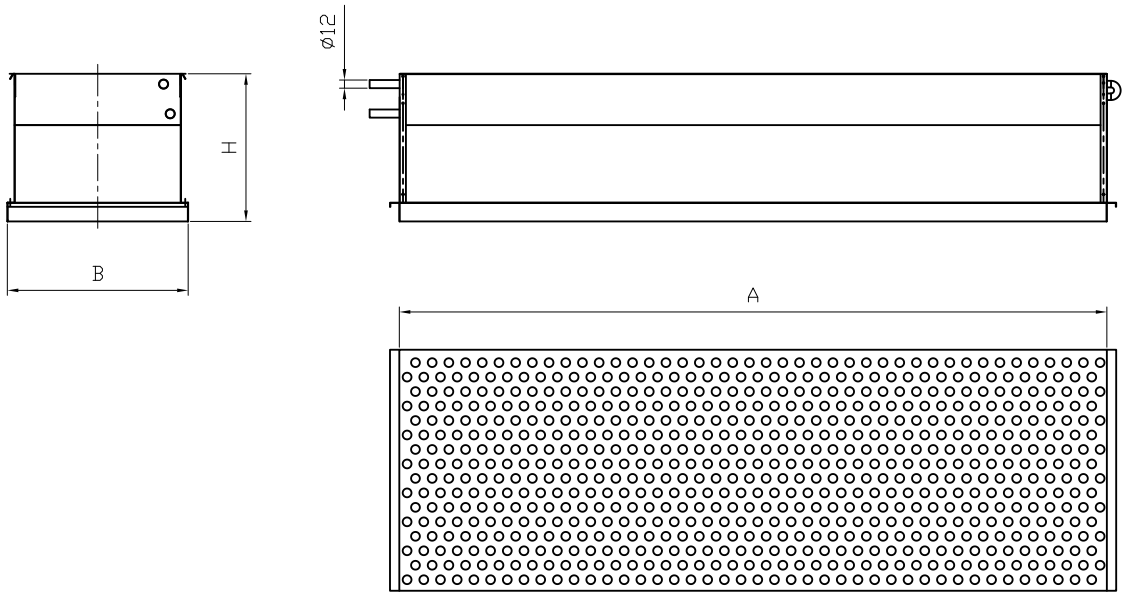


Figure 7: Airfit P Dimensions

Size	1200	1500	1800	2400	3000
A (mm)	1194	1494	1794	2394	2994
B (mm)	295/595	295/595	295/595	295/595	295/595
H (mm)	120, 200 or 300mm				

Table 1: Airfit P Dimensions

Performance Data

Cooling Capacities

The cooling capacities of passive chilled beams are rated on a watt per meter length basis and vary according to the difference between the room temperature and the mean of the entering and leaving chilled water temperatures as shown below in figure 8 and 9. Typically the chilled water supply temperature is 16 degrees C and the leaving water temperature 19 degrees C, giving a mean temperature of 17.5 degrees C. The cooling capacity also varies according to the height of the unit and its skirt – dimension H. Unit capacities are shown below in figures 8 and 9.

Cooling Capacity Model 300

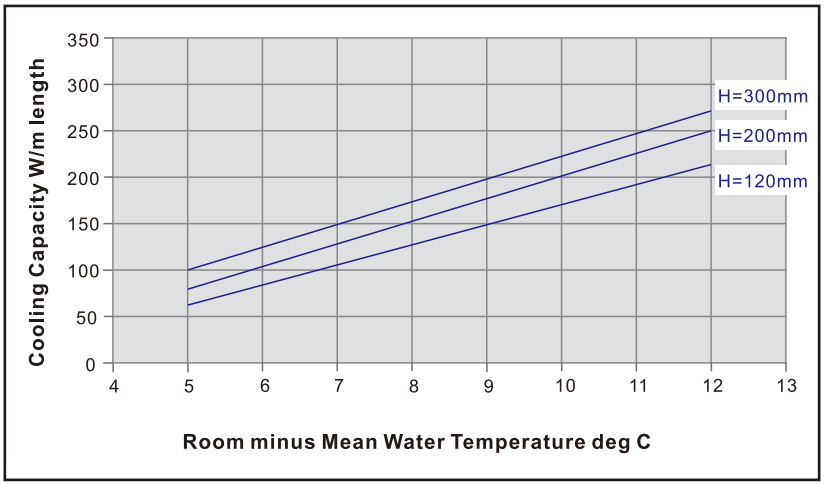


Figure 8: Cooling capacity model 300

Cooling Capacity Model 600

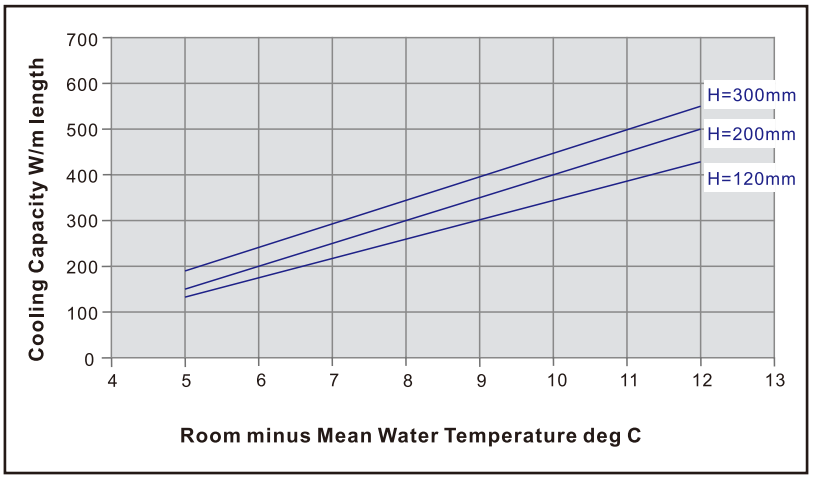


Figure 9: Cooling capacity model 600

Note: Performances are based on chilled water flow rate of 0.03 l/s, outlet diffuser free area of 50% and minimum distance between the top of the chilled beam and any air flow obstruction above is 50% of the passive chilled beam width.

Cooling Capacity Correction Factors

The cooling capacity is also affected by the following which need to be taken into account when determining the overall cooling capacity:

• The distance between the top of the unit and the floor slab above – dimension H1. Where there is free air flow to both sides of the unit H1 should not be less than 25% of the unit width B. If the chilled beam is located adjacent to a wall within a distance of B or less than H1 should not be less than 50 % of B.

• The free area of any diffuser or screen below the heat exchanger.
Capacity correction factors are detailed below:

Free Area	Correction Factor
30%	0.78
40%	0.88
50%	1.00
100%	1.06

Table 2: Diffuser free area capacity correction factors

• Chilled water flow rate

The capacities in figures 8 & 9 are based on a chilled water flow rate of 0.03 l/s. For other flow rates the capacities from figure 8 & 9 should be multiplied by the correction factors from figure 10 below.

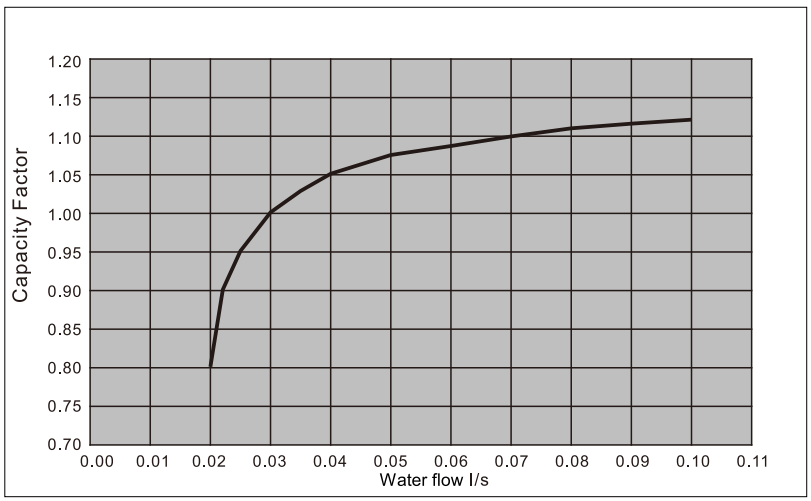


Figure 10: Cooling Capacity Correction Factors for Chiiled Water Flow Rates

Chilled Water Pressure Drop

The chilled water pressure drop can be determined from figure11 below.

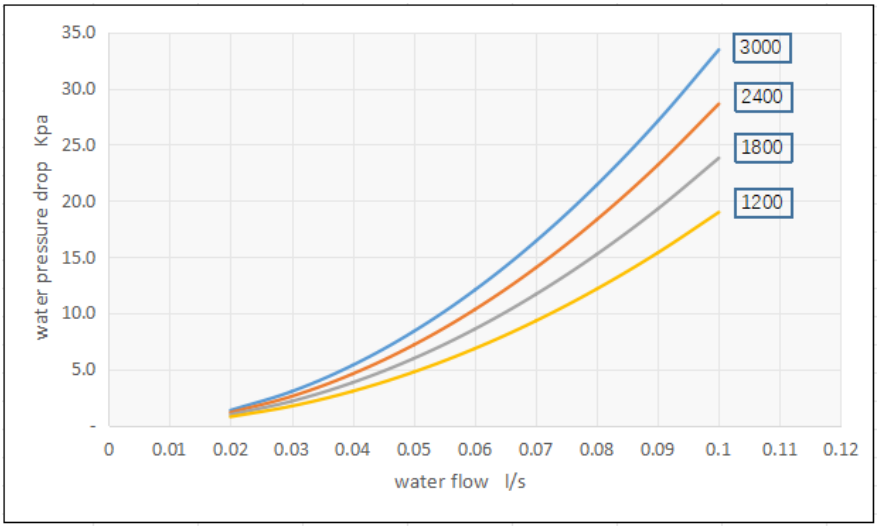


Figure 11: Chilled Water Pressure Drop

Selection Example

Specified data

Office (L x W x H)	5.4 x 3.6 x 2.7m
Ceiling	Metal panel 600mm x 600mm grid
Occupants	2 Persons
Minimum ventilation	2 x 10l/s
Indoor design condition	25 deg C db with 50% RH (Room dew point 14 deg C)
Chilled water supply temperature	16 deg C (Room dew point 14 deg C plus 2 deg C)
Chilled water return temperature	19 deg C
Required room sensible cooling	800W

Calculation

The temperatures required to select the passive chilled beams are:

T room	= 25 deg C
T mean water temp	= (16 + 19) divided by 2 = 17.5 deg C
T room minus T mean water temp	= 25 – 17.5 = 7.5 deg C
Chilled water temperature rise	= 19 – 16 = 3 deg C

Required chilled water flow to achieve 3 deg C water temperature rise with 800 W cooling
= 800 / (4187x 3) = 0.064 l/s.

Selection

Based on the 800W cooling requirement and a chilled water flow of 0.064 l/s the required cooling capacities in W/m are as follows:

Length mm	Cooling Capacity	Water Flow Correction Factor from Figure 10	Nominal cooling capacity required from figure 9
1800 mm	444 W/m	1.09	407 W/m
2400 mm	333 W/m	1.09	306 W/m

From figure 9 with Troom – Tmean water temp = 7.5 deg C select Airfit-P 600-2400 with 300 height having a nominal capacity of 370 W/m which exceeds the requirement of 306W/m.

With 370W/m and a chilled water flow rate of 0.064 l/s the available cooling capacity = 321x 2.4x 1.09 = 840W and the chilled water temperature rise = 840 / (4187 x 0.064) = 3.1 deg C.

From figure 11 the chilled water pressure drop = 8.2 Kpa.

This selection can be summarized as follows:

Room Temperature	deg C	25
Entering & Leaving Water Temperatures	deg C	16/19
Mean Water Temperature	deg C	17.5
Room Temperature minus Mean Water Temperature	deg C	7.5
Airfit-P Width	mm	600
Airfit-P Height	mm	300
Nominal Cooling Capacity per meter	W/m	321
Airfit-P Length	mm	2400
Nominal Cooling Capacity	W	770
Selected Water Flow	l/s	0.064
Capacity Correction Factor for Water Flow		1.09
Corrected Capacity	W	840
Chilled Water Temp Rise	deg C	3.1
Chilled Water Pressure Drop	Kpa	8.2

Guide Specification

Example

A passive chilled beam system shall be used to compensate for the heat loads in the building and shall maintain the thermal comfort of the occupied areas within the required comfort parameters.

System Description

The system shall comprise Barcol-Airfit P passive chilled beams installed in the ceiling to provide the cooling required to offset the sensible cooling loads of the occupied area. The passive chilled beams will be supplied with chilled water at 16 degrees C and the chilled beams shall be selected with a 3 degree water temperature rise.

The ventilation and humidity control of the occupied space shall be taken care of using a separate primary air system using 100% fresh air conditioned supplied from a central air handling unit. The central air handling unit shall supply primary air at reduced humidity level to ensure the room dew point is maintained at least 2 degrees C below the temperature of the chilled water supplied to the passive chilled beams.

Construction and Performance

- Each passive chilled beam shall comprise an air to water heat exchanger, body and skirt to enhance the heat transfer. The beams shall be nominally 600mm wide to match the projects ceiling grid and shall have an overall length of 1,800 mm.
- The heat exchanger shall be constructed from seamless copper tube with aluminum fins with a fin spacing of 8mm. Each heat exchanger shall be suitable for operation with a water pressure of 15 bar and shall be factory leak tested at 20 bar pressure.
- The body and skirt of the passive chilled beams shall be manufactured from electro galvanized steel with a thickness of at least 0.8mm.
- The passive chilled beams shall be provided with optional perforated air diffusers with a free area of at least 50% installed below the passive chilled beams. The diffusers shall be manufactured from electro galvanized steel with a thickness of at least 0.8mm and shall be finished with RAL9010 20% gloss polyester powder paint.
- The passive chilled beam assembly shall be suitable for suspension from the floor slab above the ceiling using threaded rod or a steel wire hanging system attached to the passive chilled beams using factory supplied hanging brackets.
- The passive chilled beams shall be tested and rated in accordance with standard EN14518.