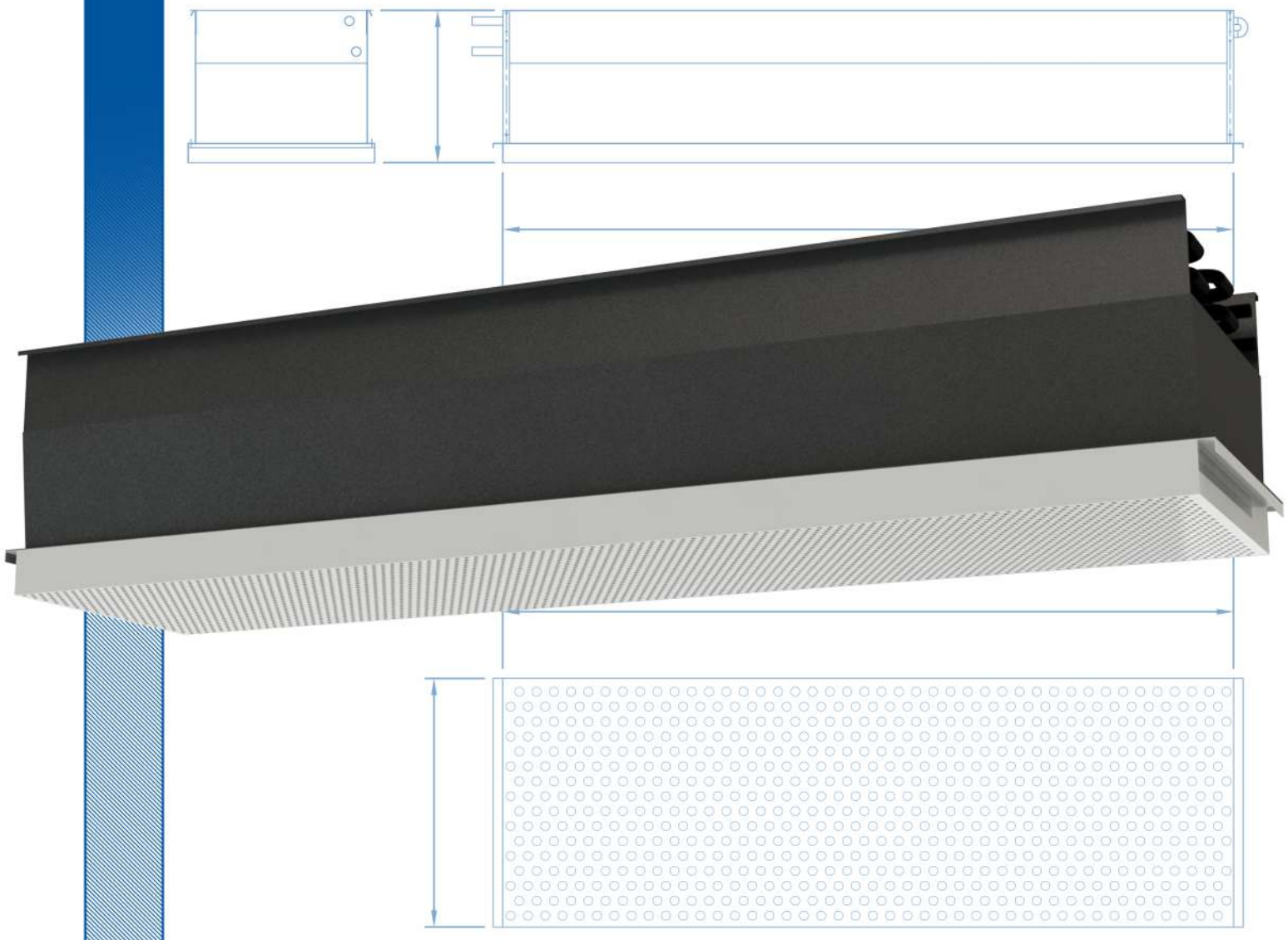
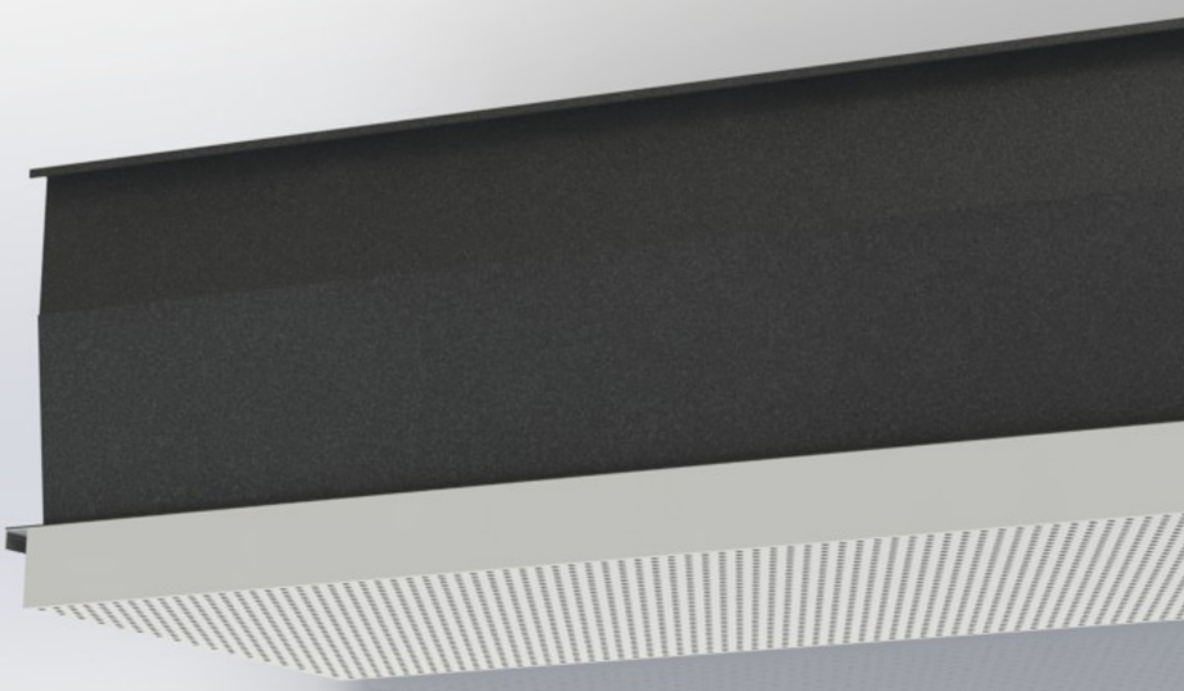
AFX-OHPCB

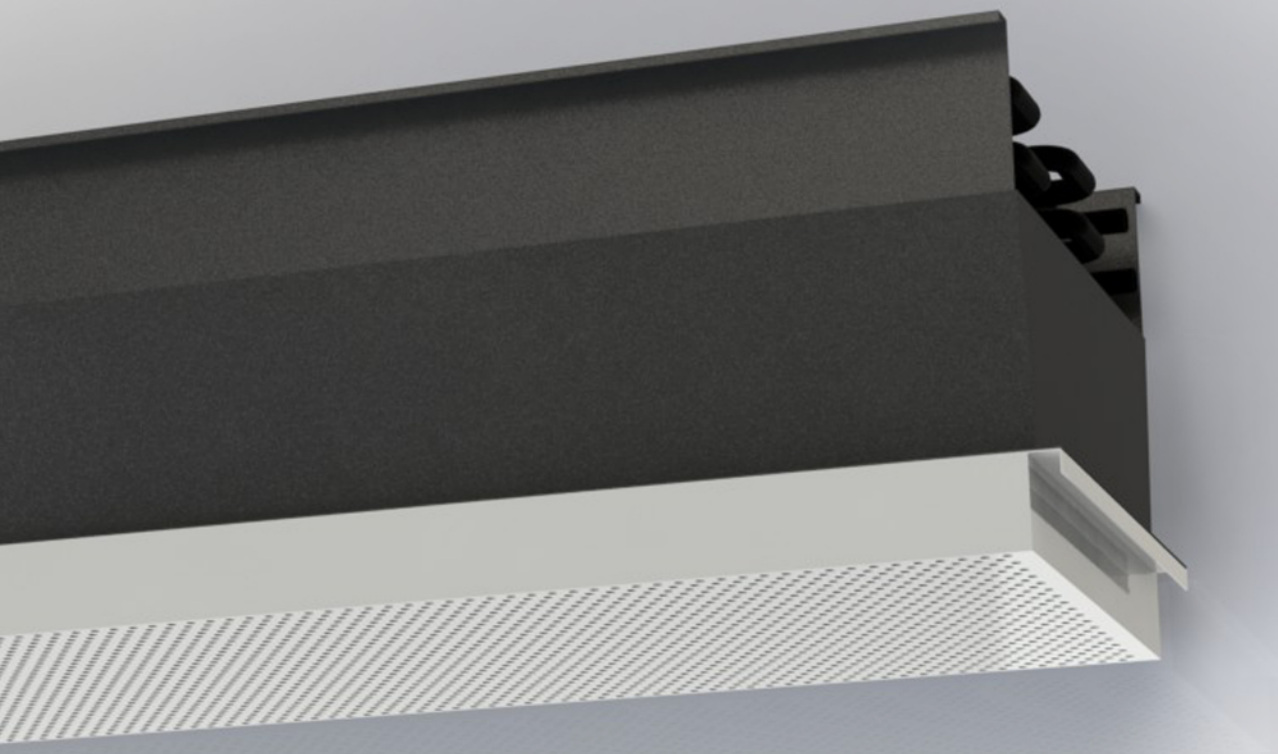
Overhead Passive Chilled Beam



AirFixture®

AirFixture Overhead Passive Chilled Beam (OHPCB) systems are designed to achieve effective cooling with a minimal energy cost. Utilizing chilled water as a basis of operation, these units are suitable for a wide variety of air-conditioning applications where reduced operating costs are a priority. These systems provide full cooling, heating, ventilation and humidity control – all with silent operation and minimal maintenance requirements.





CONCEPT

The principle of the Overhead 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 satisfied using separate primary conditioned air supplied by a central air handling unit.

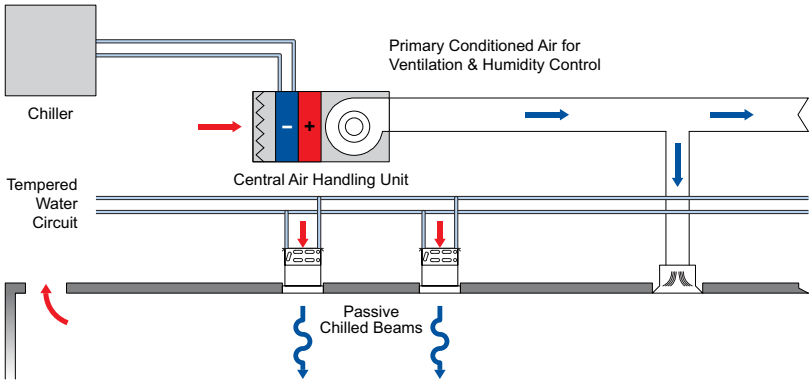


FIGURE 1: Overhead Passive Chilled Beam System

Cooling from the AFX-OHPCB is achieved by natural convection. The air surrounding the heat exchanger is cooled as it comes into contact with the exchanger; as air temperature is reduced the density of the air increases, resulting in a downward air flow pattern. This happens without the need for any external energy to move the air, resulting in large energy savings which is the primary benefit of the system.

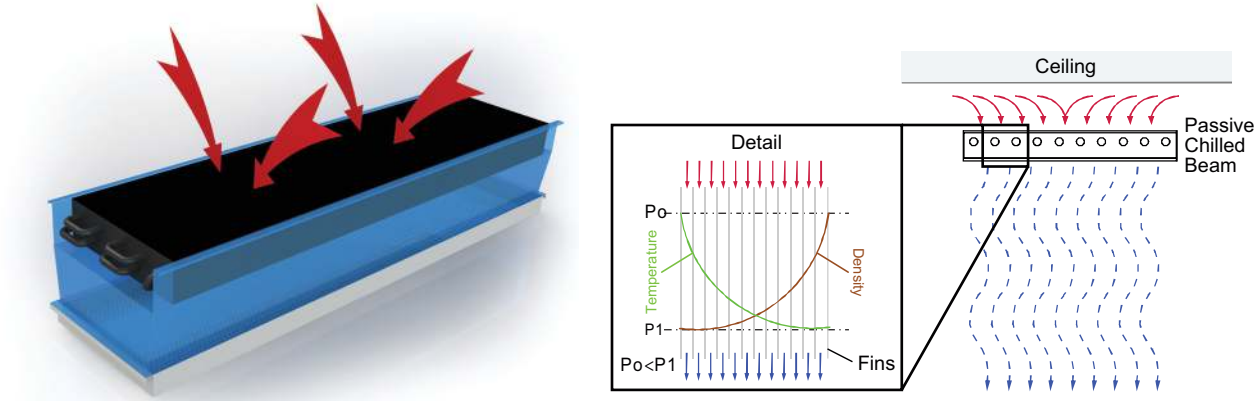


FIGURE 2: Passive Chilled Beam Natural Convection

Since the separate primary air system is required only for ventilation and humidity control, the amount of air can be reduced substantially verses conventional air systems. The primary air can often be reduced to the minimum amount 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 room humidity level above the dew point temperature of the AFX-OHPCB, so that the heat exchanger operates without condensation. This avoids many of the maintenance and health concerns associated with other terminal heat exchangers, 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 AFX-OHPCB, the primary air should be pretreated in a central air handling unit so that it can maintain the room dew point temperature approximately 1–3°F (1–2°C) below the entering chilled water temperature (EWT is typically 57°F [14°C]). Additionally, the building ventilation system should be controlled to maintain a small amount of positive pressure in the building, ensuring that any air infiltration is exiting the building. For instance, if a window is left open air flow should be out of the building, preventing 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. These sensors will close the chilled water supply or reset the chilled water temperature to a higher level if they detect that the dew point of the air surrounding the chilled water piping is approaching saturation.

APPLICATION CONSIDERATIONS

Air Distribution

Because the AFX-OHPCB operates using natural convection, cooled air flows downwards from the unit. It is therefore important to locate units carefully in order to avoid down drafts above the room occupants. Units are best placed above unoccupied areas and are typically installed adjacent to perimeter walls or corridor walls.

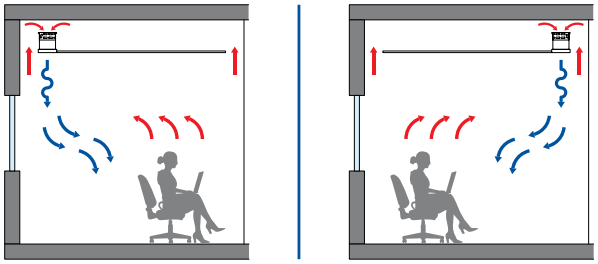


FIGURE 3: Recommended Placement of Chilled Beam

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 AFX-OHPCB.

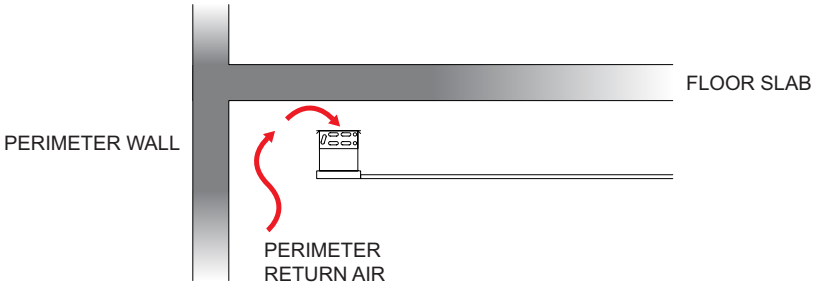


FIGURE 4: Air Path for Return Air

Chilled Beam Skirt

The performance of the passive chilled beam 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.

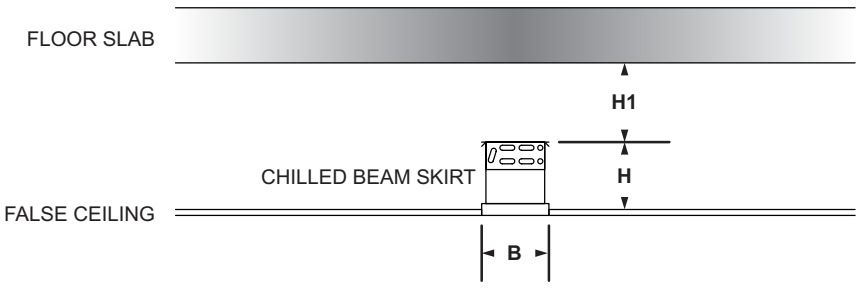


FIGURE 5: Free Space Above the Chilled Beam

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 the Chilled Beam

AFX-OHPCB 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 FEATURES

Configuration Options

AFX-OHPCB passive chilled beams are available in a variety of configurations to match the meet the specific needs of different projects:

- Nominal unit heights of 5" (120mm), 8" (200mm) and 12" (300mm) – including the chilled beam skirt – to match various performance and available space needs.
- With or without outlet diffusers. Available diffuser configurations include:
  - Perforated (standard)
  - Linear
  - Metal Mesh
  - Egg Crate

Variable Sizes & Capacities

The AFX-OHPCB is available in different widths – nominally 12" (300mm) and 24" (600mm) as standard to match with most ceiling systems. Multiple lengths are available in increments of 12" (300mm), from 48" (1200mm) to 120" (3000mm). Customized widths & lengths can be made available to match particular project requirements.

Simple Mounting

Units can be easily suspended from the overhead concrete slab, using threaded rod or hanging wire support systems to match acoustical fiber board or plaster ceilings. Units can also be installed without false ceilings.

Controls

The cooling capacity of the AFX-OHPCB 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 in the event that the surrounding air dew point temperature approaches the temperature of the chilled water inlet pipe.

Silent Operation

Air movement though the AFX-OHPCB is based solely on natural convection. The unit is therefore completely silent during operation.

Hygienic Operation

The cooling coil in the unit operates dry. As a result, there is no need for condensate drain pans in the unit and condensate drain piping. This eliminates health risks associated with algae growth in drain pans, as well as smells and problems that can arise from stagnant condensate in drain pans and drain pipes.

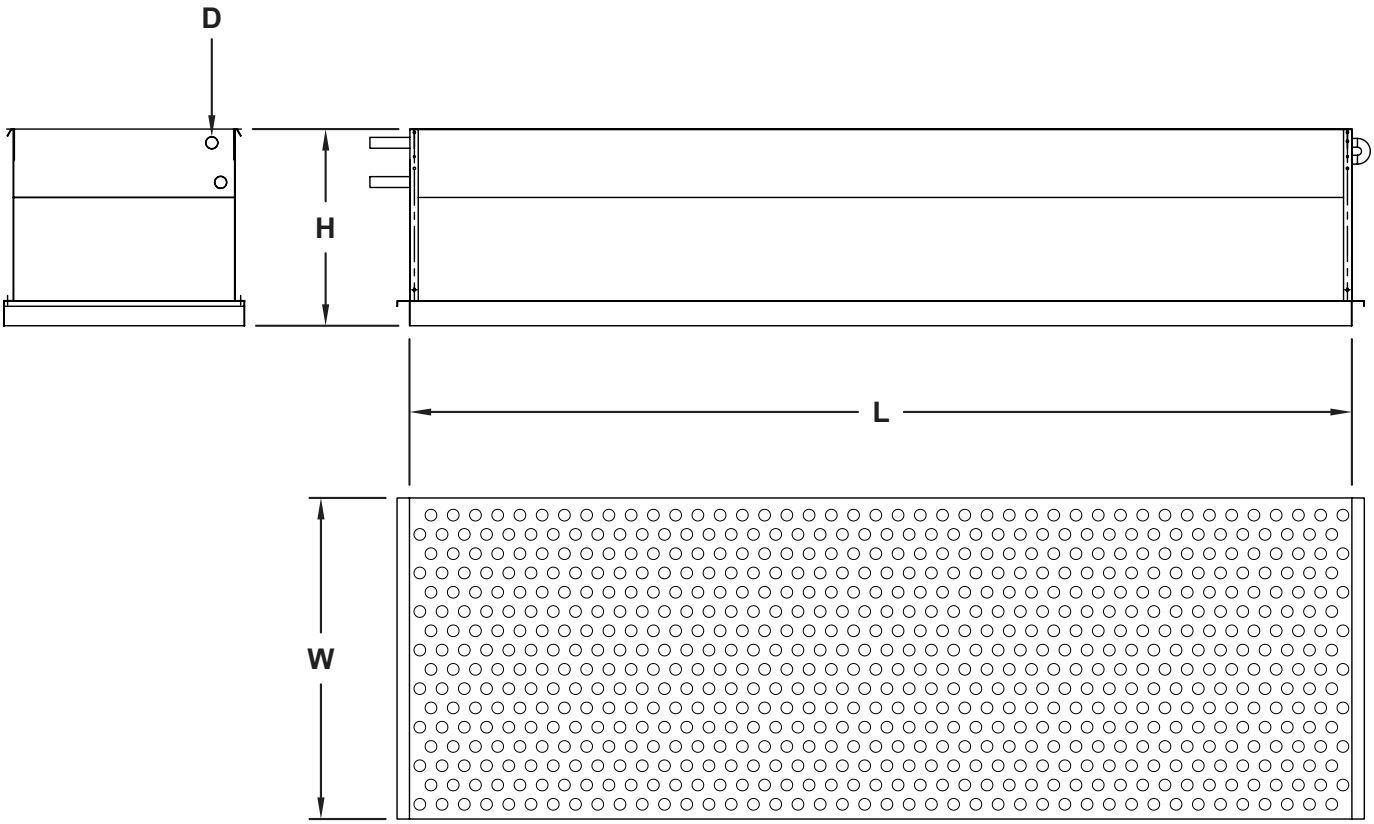
Ventilation Humidity & Air Quality Control

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

Low Maintenance

AFX-OHPCB series passive chilled beams include no fans / motors, air filters, condensate pans, drains, or any other moving parts. As a result, maintenance is limited to cleaning the exposed metal surfaces and removing dust from the coil every 2–5 years, depending on the cleanliness of the supply air.

DIMENSIONS



UNIT SIZE	48" (1200mm)	60" (1500mm)	72" (1800mm)	96" (2400mm)	120" (3000mm)
L	47-3/4" (1194mm)	59-3/4" (1494mm)	71-3/4" (1794mm)	95-3/4" (2394mm)	119-3/4" (2994mm)
W	11-3/4" | 23-3/4" (295mm | 595mm)				
H	5" | 8" | 12" (120mm | 200mm | 300mm)				
D	1/2"Ø (12mm)				

PERFORMANCE DATA

Cooling Capacities

The cooling capacities of passive chilled beams are rated on a Btu/h-per-foot 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 Figures 6 & 7. Typically the chilled water supply temperature is 61°F and the leaving water temperature 66°F, giving a mean temperature of 64°F. The cooling capacity also varies according to the height of the unit and its skirt (dimension H). Unit capacities are shown in FIGURES 6 & 7.

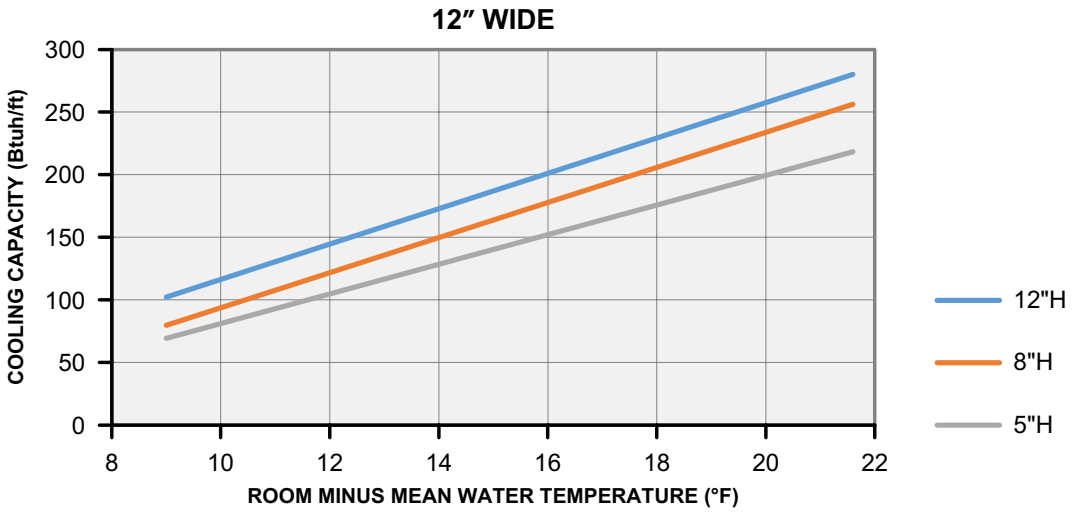


FIGURE 6

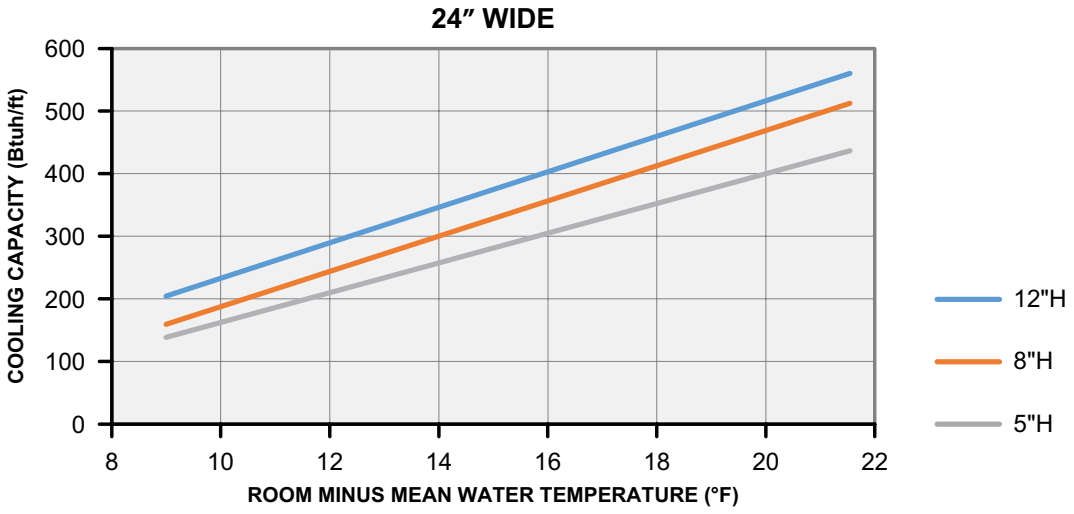


FIGURE 7

NOTE: Performance is based on chilled water flow rate of 0.5 gpm, 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

Cooling capacity is affected by the following factors, which need to be taken into account when determining 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 then 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 in TABLE 1.

FREE AREA	CORRECTION FACTOR
30%	0.78
40%	0.88
50%	1.00
100%	1.06

TABLE 1

- **Chilled water flow rate.** The capacities in FIGURES 6 & 7 are based on a chilled water flow rate of 0.5 gpm (0.03 l/s). For other flow rates the capacities should be multiplied by the correction factors from FIGURE 8.

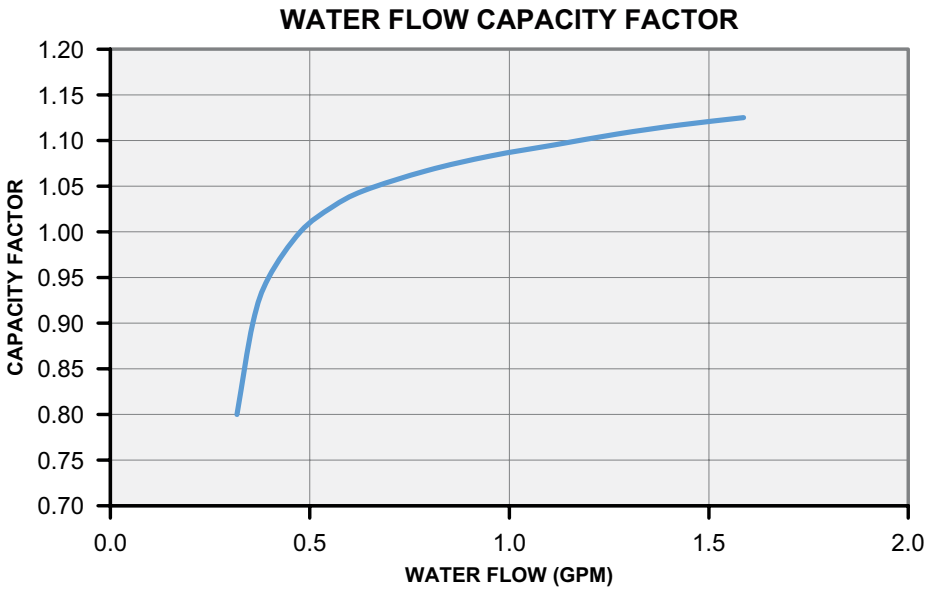


FIGURE 8

PERFORMANCE DATA

Chilled Water Pressure Drop

The chilled water pressure drop can be determined from FIGURES 9 & 10 below.

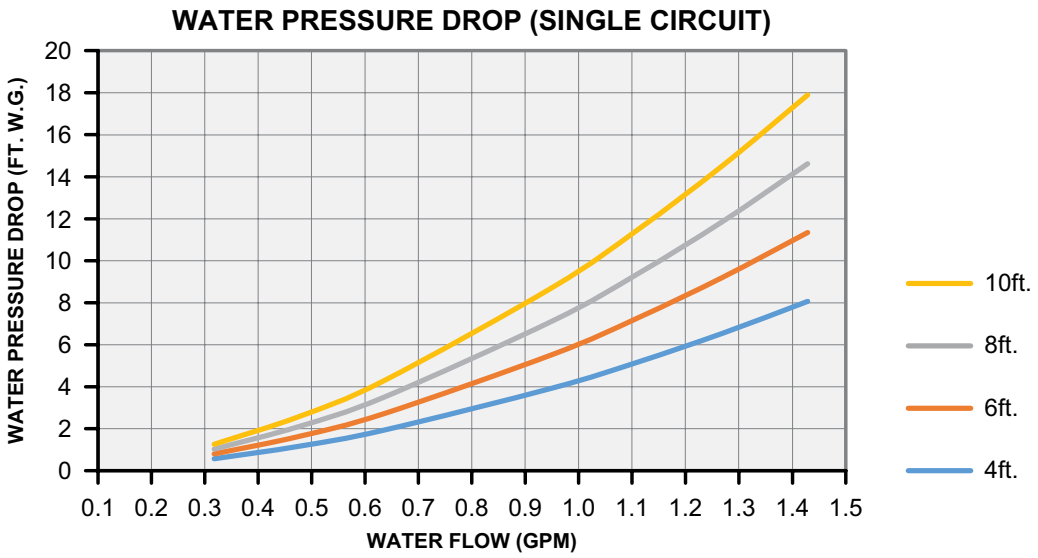


FIGURE 9

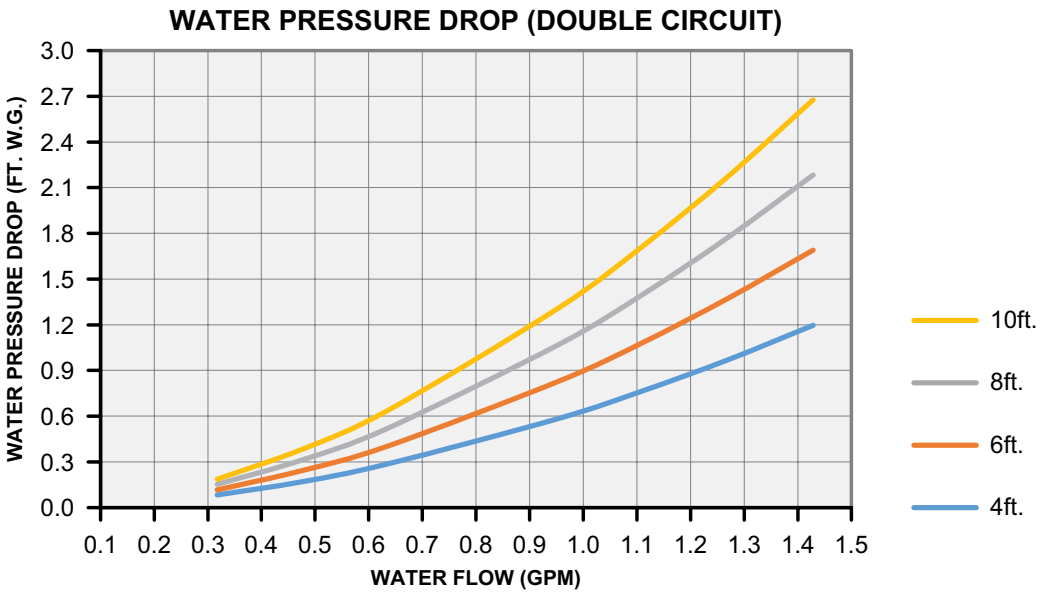


FIGURE 10

SELECTION EXAMPLE

Specified Data

Office (LxWxH):	17.7' x 11.8' x 8.9'
Acoustical Ceiling:	Metal Panel | 24" x 24" Grid
Occupants:	2
ASHRAE 62-2010 Minimum Ventilation:	(2 people x 21.2 cfm)
Indoor Design Condition:	77°F db / 50% RH | Room Dew Point 57°F
Chilled Water Supply Temperature:	61°F | Room Dew Point 57+2°F
Chilled Water Return Temperature:	66°F
Required Room Sensible Cooling:	2730 Btu/h (People + equipment, lights & envelope sensible loads)

Calculation

Troom	77°F
Tmean Water Temperature	(61 + 66°F) / 2 = 63.5°F
Troom – Tmean Water Temperature	77 - 63.5°F = 13.5°F
Chilled Water Temperature Rise	66 - 61°F = 5°F
Required Chilled Water Flow Rate to Achieve 5°F Water Temperature Rise with 2730 Btu/h Cooling	1.0 gpm

Selection

Based on 2730 Btu/h cooling requirement and a chilled water flow of 1.0 gpm the required cooling capacities in Btu/h are as follows:

LENGTH	COOLING CAPACITY	WATER FLOW CORRECTION FACTOR	NOMINAL COOLING CAPACITY REQUIRED
(ft)	(Btuh/ft)	(from FIGURE 8)	(from FIGURE 7)
6	257		
8	193		

Room Temperature	**°F**	77
Entering / Leaving Water Temperatures	**°F**	61 / 66
Mean Water Temperature	**°F**	63.5
Mean Water Temperature Subtracted From Room Temperature	**°F**	13.5
AFX-OHPCB Width	**ft**	2
AFX-OHPCB Height	**ft**	1
Nominal Cooing Capacity Per Foot	**Btuh/ft**	186
AFX-OHPCB Length	**ft**	8
Nominal Cooling Capacity	**Btuh**	2627
Selected Water Flow	**gpm**	1.0
Capacity Correction Factor For Water Flow	**-**	
Corrected Capacity	**Btuh**	2866
Chilled Water Temperature Rise	**°F**	5
Chilled Water Pressure Drop	**ft. w.g.**	2.7

GUIDE SPECIFICATIONS

AirFixture AFX-OHPCB series passive chilled beam systems shall be used to compensate for heat loads in a building and shall maintain the thermal comfort of the occupied areas within the required comfort parameters.

Functional Description

The system shall comprise AirFixture AFX-OHPCB series passive chilled beams installed in the ceiling to provide cooling required to offset the sensible cooling loads of the occupied area.

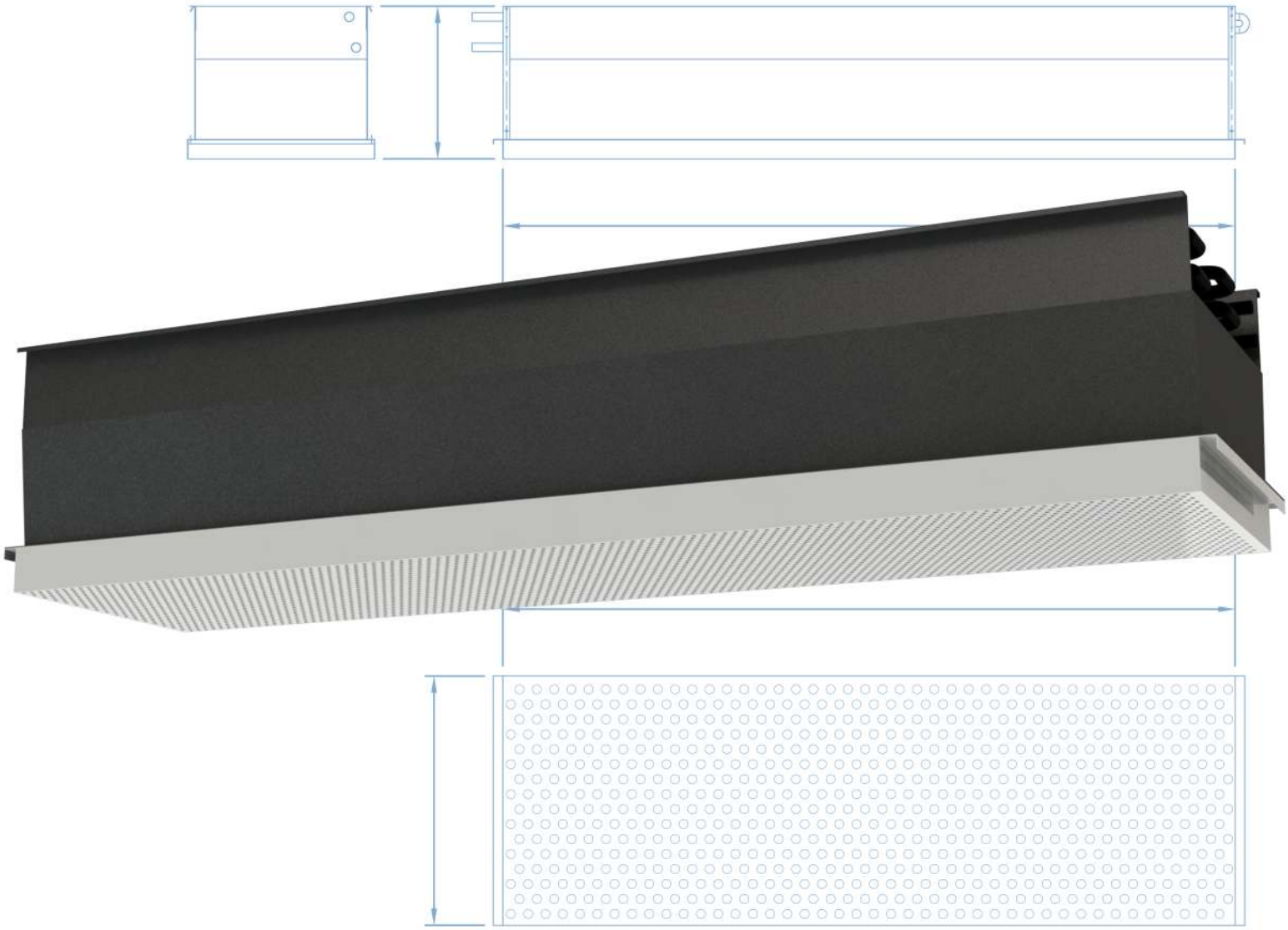
Ventilation and humidity control of the occupied space shall be handled by a separate primary air system using air supplied from a central air handling unit. The central air handling unit shall supply primary air at reduced humidity levels to ensure room dew point is maintained at least 1–3°F (1–2°C) 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 heat transfer. The beams shall be nominally 24" (600mm) wide to match the projects ceiling grid and shall have an overall length of 72" (1800mm).
- The heat exchanger shall be constructed from seamless copper tube with aluminum fins with a fin spacing of 3 Fpi. Each heat exchanger shall be suitable for operation with a water pressure of 250 psi and shall be factory leak tested at 300 psi pressure.
- The body and skirt of the passive chilled beams shall be manufactured from electro galvanized steel with a thickness of at least 22 ga. (0.8mm).
- The passive chilled beams shall be provided with optional perforated air diffusers that have 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 22 ga. (0.8mm) and finished with RAL9010 30% gloss polyester powder paint.
- **The passive chilled beams shall be tested and rated in accordance with Standard EN14518.**

Installation

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.



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51 Kansas Avenue | Kansas City, KS 66105 | P: 913.312.1100 | F: 913.312.1105 | www.airfixture.com