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Chilled Beams in Health Care Facilities

The adoption of chilled beam technology in North America has grown dramatically in recent years as sustainable building practices become the norm. Use of chilled beams in laboratories, commercial and public spaces, as well as educational facilities has been prominent and there is a growing interest in the potential benefits of applying the same technology to the health care sector.

Chilled beams are available in active or passive configurations. An active chilled beam (ACB) incorporates a heating/cooling coil, plenum box, supply air inlet, internal nozzles and frame. ACB's utilize induction to cool or heat the room by forcing primary ventilation air through the internal nozzles, which in turn, pulls room air through the coil. The conditioned room air then mixes with the primary supply before discharging into the room. Passive chilled beams (PCB) include a cooling coil and engineered shroud designed to direct airflow through the coil. PCB's do not have a primary air supply and use natural convection to cool room air by drawing surrounding warm air through the coil, cooling the air as is passes into the occupied space.

Figure 1 - Active Chilled Beam in cooling mode

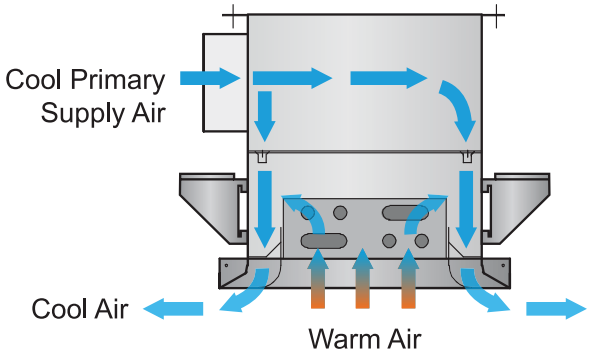
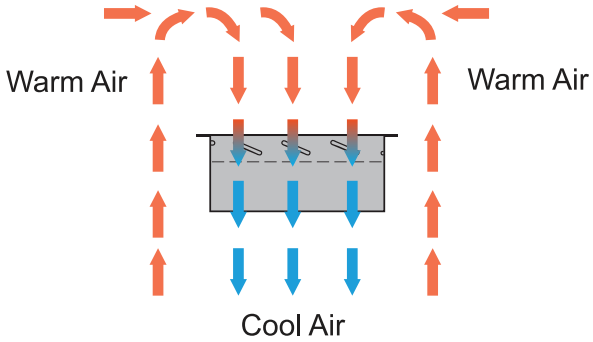


Figure 2 - Passive Chilled Beam



The organizations which are recognized and referred to for design guidance by most North American health care engineers are ASHRAE and the AIA / Facility Guidelines Institute (FGI). Chilled beams most closely fit the definition of recirculating room units within the context of these organization's standards/guidelines. Based on this definition, the suitability of chilled beam application throughout the health care facility can be determined using the following references:

- ASHRAE standard 170-2008, Ventilation of Health Care Facilities / Table 7-1
- 2006 AIA/FGI Guidelines for Design and Construction of Health Care Facilities / Table 2.1-2

The pertinent information from the above references has been reproduced on the last page of this document.

NOTE: Chilled beams can be considered recirculating room units as defined by applicable standards/ guidelines but approval for use must still be granted by the authority having jurisdiction.

Patient rooms represent the one of the spaces most commonly considered for chilled beam application and will therefore be used for reference throughout the remainder of this document.

Each of the aforementioned standards requires that an occupied patient room connected to a recirculating air handling system have a minimum of 6 total air changes per hour which should include a minimum of 2 outdoor air changes. One of the primary advantages to using chilled beams in patient rooms is that the primary air volume can be reduced to the outdoor air requirement. The induction rates for chilled beams range from 4-8 times, thereby providing sufficient air exchange rates. This recirculation of room air is considered acceptable by applicable standards for achieving total room air change rates [reference provided below]. Induction rates of ACB's depend on many factors including nozzle size and spacing, inlet static pressure, and beam construction/geometry. Induction rate information should be obtained from the manufacturer to ensure the minimum total room air change requirement is satisfied.

Other advantages include:

- Improved energy efficiency with less fan brake horsepower through reduced air volumes
- Reduced call for reheat energy due to decoupling of ventilation and zone loads, which leads to significant life cycle energy cost savings
- Potential higher chiller water temperature differentials which may improve overall chiller efficiency
- Lower maintenance cost compared to other room air recirculating units, with no fans, filters, drain pans or condensate pumps
- Potential for reduced floor-to-floor building height due to smaller supply air ductwork
- Elimination of air recirculation between spaces since the use of chilled beams favors the use of 100% outside air units, lowering the risk of nosocomial infection
- Increased usable floor space in the Hospital, due to smaller air handling equipment and vertical ductwork

The 2006 AIA/FGI guidelines currently represent the most widely accepted design document for health care facilities in North America. AIA/FGI is clear about the intended function of recirculating room units and has no restriction regarding their use in patient rooms as demonstrated by the following referenced statements:

> *Non-central air handling systems (i.e., individual room units used for heating and cooling purposes, such as fan-coil units, heat pump units, etc.). These units may be used as recirculating units only. All outdoor air requirements shall be met by a separate central air-handling system with proper filtration. (Page 118)*
>
> *Use of supplemental recirculating devices shall be permitted in the patient room to increase the equivalent room air exchanges; however, such recirculating devices do not provide outside air requirements. Recirculation of air within individual isolation rooms shall be permitted if HEPA filters are used. (Page 119)*
>
> *Recirculating room HVAC units refers to those local units that are used primarily for heating and cooling of air, and not disinfection of air. (Page 132)*

The 2010 AIA/FGI guidelines now reference ASHRAE standard 170-2008 for ventilation rates, instead of providing their own requirements. Prior to the decision by the AIA/FGI to incorporate the ASHRAE standard into their own design material, both documents were similar and used identical wording in many cases. In reference to the use of recirculating room units in patient rooms, ASHRAE standard 170-2008 includes the following statement:

> *Recirculating room HVAC units (with heating or cooling coils) are acceptable to achieve the required air change rates [in patient rooms]. Because of the cleaning difficulty and the potential for buildup of contamination, recirculating room units shall not be used in areas marked "No" [patient rooms are not marked "No" in the referenced table].... Gravity-type heating or cooling units, such as radiators or convectors, shall not be used in operating rooms and other special care areas. (Page 10, Table 7-1 notes)*

Air handling units (AHU) serving inpatient care spaces (i.e. patient rooms) require two separate filtration banks. The first filtration bank should be upstream of heating/cooling coils such that all mixed air is filtered and the second filtration bank should be downstream of all cooling coils that remove moisture from the air. The filter efficiencies should be 25% and 90% respectively as specified by ASHRAE standard 170-2008 (30% and 90% for 2006 AIA/FGI guidelines). Current ASHRAE and AIA/FGI standards/guidelines do not include a requirement for filters in recirculating room units (i.e. chilled beams). Some states, such as California, do not currently distinguish between wet and dry cooling coils, and would require filters downstream of any recirculating room unit cooling coil. In these cases, Authorities Having Jurisdiction should be approached with an "Alternate Means & Methods Request" where allowed, based on the allowances under AIA/FGE & ASHRAE guidelines for dry coils without downstream filters.

In a chilled beam system, the AHU is required to provide primary air to the beam in order to deliver outside air to the occupied space as well as provide a means for room air induction to achieve the desired capacity. AHU's should meet the filtration requirements of the standards as described above. However, chilled beams must only comply with standards and requirements pertaining to recirculating room units.

In summary, chilled beams present an opportunity for significant energy savings, reduced capital investment and better space utilization in health care facilities. With regard to ASHRAE, AIA/FGI, and OSHPD of California, chilled beams can be considered recirculating room units and applied as such. However, final approval for application of chilled beam technology in the health care facility must be granted by the authority having jurisdiction.

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Function of Space	Recirculating Room Units Acceptable
SURGERY AND CRITICAL CARE	
Class B and C operating rooms	No
Surgical cystoscopic rooms	No
Delivery room (Caesarean)	No
Substerile service area	No
Recovery room	No
Critical and intensive care	No
Wound intensive care (burn unit)	No
Newborn intensive care	No
Treatment room	Yes
Trauma room	No
Medical/anesthesia gas storage	Yes
Laser eye room	No
ER waiting rooms	Yes
Triage	Yes
ER decontamination	No
Radiology waiting rooms	Yes
Class A Operating/Procedure room	No
INPATIENT NURSING	
Patient room	Yes
Toilet room	No
Newborn nursery suite	No
Protective environment room	No
Airborne infection isolation room	No
Airborne infection isolation anteroom	No
Labor/delivery/recovery/postpartum (LDRP)	Yes
Labor/delivery/recovery (LDR)	Yes
Corridor	Yes
SKILLED NURSING FACILITY	
Resident room	Yes
Resident gathering/activity/dining	Yes
Physical therapy	Yes
Occupational therapy	Yes
Bathing room	Yes
STERILIZING	
Sterilizer equipment room	No

Function of Space	Recirculating Room Units Acceptable
RADIOLOGY	
X-ray (diagnostic and treatment)	Yes
X-ray (surgery/critical care and catheterization)	No
Darkroom	No
DIAGNOSTIC AND TREATMENT	
Bronchoscopy, sputum collection, and pentamidine administration	No
Hospital laboratories	No
Autopsy room	No
Non-refrigerated body-holding room	No
Pharmacy	Yes
Examination room	Yes
Medication room	Yes
Endoscopy	No
Endoscope cleaning	No
Treatment room	Yes
Hydrotherapy	Yes
Physical therapy	Yes
CENTRAL MEDICAL AND SURGICAL SUPPLY	
Soiled or decontamination room	No
Clean workroom	No
Sterile storage	Yes
SERVICE	
Food preparation center	No
Warewashing	No
Dietary stroage	No
Laundry, general	No
Soiled linen sorting and storage	No
Clean linen storage	Yes
Linen and trash chute room	No
Bedpan room Bathroom	No
Janitor's closet	No
SUPPORT SPACE	
Soiled workroom or soiled holding	No
Clean workroom or clean holding	Yes
Hazardous material storage	No