TECH TIPS

Condensate and Chilled Beam Cooling Coils

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In a previous Tech Tip, I discussed the concept of condensate formation on cool surfaces, such as radiant panels or cooling coils. It is a topic of great interest when discussing the application and selection of active chilled beams, particularly when the building in question is located in a humid climate.

As most designers and end users have concerns about the potential for condensation, it is common for the concept of using a condensate pan to be considered. To me, using a condensate pan appears to be an expensive option for active chilled beams, as the beams are often located in the ceiling and would require a condensate pump on each beam, or a sloped ceiling to allow the condensate to properly drain. A coil with condensate (moist fins) would require a filter for the induced air since the moisture will act like 'glue', and tends to bond the particulates to the fins (see Figure 1). Over time, the particulate deposition can fill the spaces between fins in a cooling coil and would require cleaning the coil. As a result, operating a chilled beam in latent mode (moisture removal) tends to have a more stringent maintenance routine, as filters must be inspected frequently and drain pans checked to verify that moisture and biological materials are not building up. A sensible only cooling coil does not have any of these issues associated with it.

The physics are straight forward – condensate pans are not required if the system is designed to use chilled supply water that is above the zone dew-point temperature and considered safe, particularly if both a proactive and reactive control approach are taken. One type of proactive control is zone humidity, or dew-point monitoring, and chilled water supply temperature moderation. A type of reactive control would be a condensate sensor that is mounted to the piping, servicing the active chilled beam, where the sensor would shut off the water valve and notify the building management system when condensate forms.

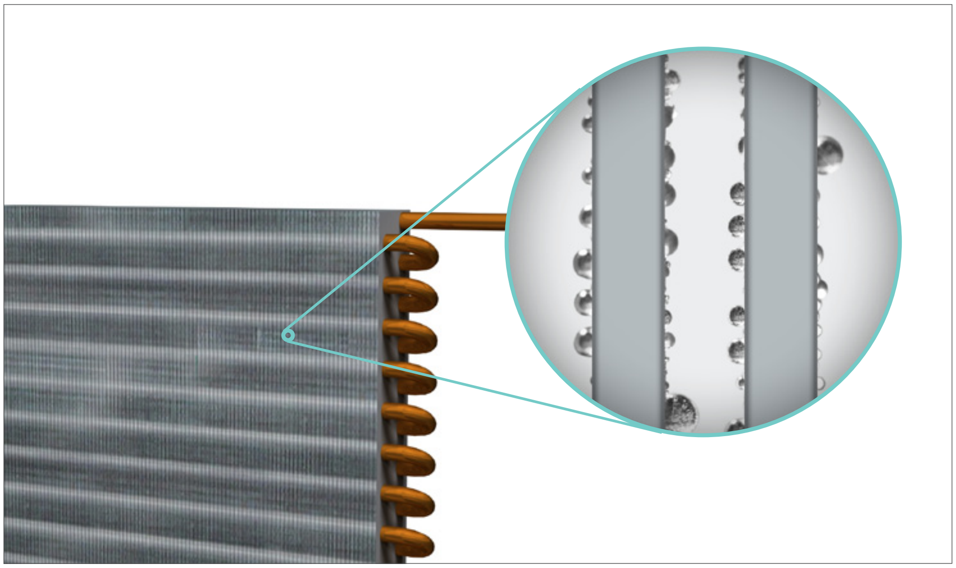

Figure 1: Coil fin with water droplets

Worldwide, there are active chilled beams installed in humid areas that do not need, nor have drain pans installed. Having stated that, most building codes have historically required drain/condensate pans for cooling coils. Recently, the chilled beam section at AHRI filed an interpretation request with the International Code Council (ICC) concerning the requirement in the International Mechanical Code (IMC) that cooling coils must have a drain pan. We asked why a sensible only cooling coil requires a drain pan, and submitted a proposed change to the language in the IMC. The ICC sent out the proposed change to the IMC and after public review, Section 307.2 (shown below) was adopted in November 2012 and becomes effective at the next printing of the IMC in 2015.

Recently, ASHRAE Standard 170 has approved addendum h, which allows the use of induction units (active chilled beams) in healthcare patient rooms. There was good discussion concerning the use of a wet versus dry cooling coil. The result of the approval of addendum h was that a cooling coil with wet fin surfaces must have at least a MERV 6 filter immediately upstream of the coil, as well as a drain pan. A cooling coil selected and operated in sensible only mode would not require a filter, or a drain pan.

Overhead mixing systems (diffusers) require a minimum of six air changes per hour (ach) to each patient room, of which at least two ach are filtered outdoor air. One of the provisions of addendum h allows active chilled beams to use the minimum required two outdoor air room changes (ach) and move the other four ach locally through induction. Significant energy can be saved with the use of active chilled beams compared to overhead mixing systems through the reduced fan power consumption, as well as lowered amounts of reheat energy required.

In the case of a chilled beam running in latent removal mode, a filter will be required to meet the provisions of addendum h. Due to the additional pressure drop by the filter, the amount of room air induced would be reduced compared to a sensible only unit without the filtration requirement. This would lead to either more beams or higher static pressures to drive the required four ach induction to make up for the reduced induction associated with the filter static pressure drop. Higher inlet static pressure requires additional fan horsepower and can lead to higher levels of sound generated by the active chilled beam. A typical chilled beam running at an inlet static pressure between 0.2 and 1.0 inches w.c. can induce from two to eight or more (depends on the model type) of room ach.

The goal is, of course, a thoroughly mixed patient room. An active chilled beam is a very effective mixing device. Active chilled beams have been installed in patient rooms in various locations across North America, and are shown in Figure 2.

Active chilled beams have a place in many types of buildings and climates.

For more information, please see the Price Engineering Handbook, or priceindustries.com

307.2: EVAPORATORS AND COOLING COILS

Condensate drain systems shall be provided for equipment and appliances containing evaporators or cooling coils. Condensate drain systems shall be designed, constructed and installed in accordance with Sections 307.2.1 through 307.2.4.

Exception: Evaporators and cooling coils that are designed to operate in sensible cooling only and not support condensation shall not be required to meet the requirements of this section.

Reason: The introduction of chilled beam technology is relatively new in the North American market. The code does not take into consideration the fact that dry coils are utilized in most chilled beam designs; it is an integral part of the design. The chilled beam products have been successfully operating in applications all over the world in this dry manner for over 25 years. Additionally, it is more hygienic and provides greater energy efficiency to design these systems with dry coils. Finally, condensation prevention strategies are already employed as part of the design of chilled beam systems.

Cost Impact: The code change proposal will not increase the cost of construction.

Figure 2: Memorial Hospital and Health Care Center