Traditional Chilled Beams – Dry cooling for maximum benefit

Background

In the mid-1980's, Swegon chilled beams emerged on the HVAC market. Developed out of the desire to create increasingly efficient water-based cooling from the ceiling, Swegon's R & D engineers have successively developed generations of radiant ceiling panels, coils using natural convection (passive chilled beams), coils using forced convection (active chilled beams), then forced convection with maximum coil utilization and air mixing (comfort module.) Millions of chilled beams manufactured by Swegon since then are evidence of success. Traditional active chilled beams and comfort modules maximize the efficiency of air and water generation and distribution. De-coupling latent cooling from these ceiling-based devices also allows the realization of other benefits. Swegon promotes the design of a proactive condensation prevention strategy rather than reactive condensation collection strategy. This document consolidates relevant information on the topic of condensation prevention in chilled beam systems.

Points to consider

Topic	Discussion with citations
Cost - energy	Most cost effective use of chilled beam system design decouples latent cooling from the room unit, providing latent cooling centrally at the AHU coil. (Rumsey & Weale, 2006) • 25% savings from centralized latent cooling • 46% savings from total cooling energy generation. • Greater chiller efficiency • More available hours of free-cooling, water-side economizer. (Rumsey, Bulger, Wenisch, & Disney, 2009)
Cost – first	Dry chilled beam systems avoid first costs by providing: • minimal casing height resulting in minimal vertical building height • smaller duct sizes contributing minimal vertical building height and lower structural costs, plus smaller ducts can result in smaller vertical shaft area allowing for greater net occupied/leasable square footage. • minimal coil size • elimination of drain pan • elimination of drainage line • elimination of condensate pump
Cost - Maintenance	Research has shown that traditional dry chilled beams do not require filters (Bjorklunds Energy & Environment Consultant, 2008), owing to absence of wet surface for particles to adhere to, coil fin spacing. If the coil is permitted to become wet, then filtration of the induced air is recommended. The cost to maintain a drain line is substantial, even if only used as a backup for collecting condensation after it occurs.
Comfort	The moderate chilled water temperatures (~57 degF) in traditional chilled beam systems result in a higher delivered air temperature, and greater occupant comfort.
Control	• Areas with operable windows have dew-point monitors to ensure that HVAC system operational parameters are adjusted as necessary to avoid condensation on the chilled beams. (Guttman & Tiffany, 2013) • Rooms with operable windows have been shown to lower the dew point and dry bulb temperature quickly after closing the window. Research into hotel room recovery times has shown that after an operable window is closed the supply air alone decreases the dewpoint to a level permitting safe operation of the cooling coil in approximately 20 minutes. (Johnsson, 2010) • In situ testing in specific applications has shown that no condensation forms on chilled beams no matter how high the humidity was increased, as long as the primary air was flowing. (Memarzadeh, 2011) • To prevent condensation, chilled water needs to be actively controlled. (Rumsey, Bulger, Wenisch, & Disney, 2009) • Chilled water temperature reset sequence of operation based on monitoring building dewpoint has been successfully implemented for decades, and is most common today (Roth, Dieckmann, Zogg, & Brodrick, 2007). Chilled beam surfaces are maintained above the dewpoint as a strategy. (Barista, 2005) • Control systems carefully and affordably monitor humidity levels. • Moderate reheat via energy recovery or hot-gas provides greater comfort and moisture control • Chilled beams with integral control can sense moisture on the chilled water pipe, in the induced airstream, before droplets form, and quickly shut CHWS valve to prevent further condensation. • Chilled beam coils are "intended to remain dry, the chilled water supply temperature should be maintained at our above the room dew-point temperature. The primary air delivered to the beam is the sole source of room dehumidification." (Loudermilk & Alexander, 2012)

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	• Due to higher cooling water temperatures there is no need for condensate drain pan, since the cooling process is not followed by dehumidification or condensation. (Ventura, 2013)
Carryover	Dry chilled beam systems reduce risk of condensate carrying over into the induced airstream. Wetting of internal chilled beam surfaces or the ceiling is prevented.
Experience	• Most chilled beams installed in US and around the world have been as part of a dry system. • Millions of Swegon chilled beams are successfully installed in dry systems.
Cleanliness	• Preventing condensation in the occupied space design is safest for the occupant and least risky for the owner. • The absence of condensation prevents need for filtration for the purpose of keeping coils and drain pans clean. (Ventura, 2013)
Code	International Mechanical Code does not require drain pans for chilled beams.
Cooling	Successful chilled beam applications separate the latent cooling (moisture removal) from the sensible cooling (air cooling) by removing the moisture centrally, at the air handler.(Barista, 2005) (Turpin, 2010)

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