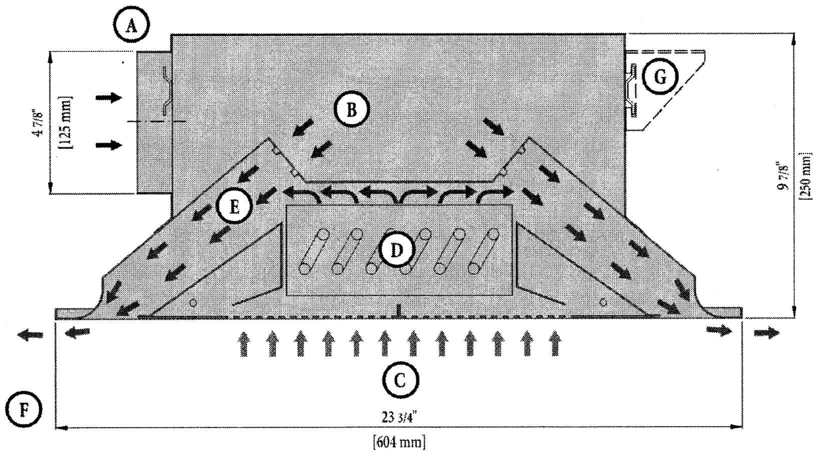
January 23, 2017

Western University Music Hall

Beam Selections and Design Criteria
(ASHRAE London – Handout)

Figure 1) How active beams work:



A – Dehumidified primary air (P/A) is pre-conditioned, and delivered to the plenum "B",
B – The primary air then passes through the nozzle plate(s) along the length of the beam, creating a series of high-speed air jets, which in turn develops a low pressure zone at the root of the nozzle plate, resulting in room air being inducted into the beam body, through the beam door "C", and coil "D".
C – Room air enters the beam door, and passes through the beam mounted coil at "D".
D – Water delivered to the coil then conditions the induced air (cooled or heated) sensibly, and mixes with the primary air within the beam body.
E – Primary air mixes with induced room air in the beam body.
F – The beam discharge air is delivered to the space, satisfying both the minimum ventilation air requirements (ASHRAE Std. 62), and the appropriate mass flow rate, to offset the latent loads in the space. The discharge air is also used to either cool or heat the space, depending on the beam's configuration.
G – Mounting bracket. (Typ. 4-6 pcs/beam, dependent upon length)

In the selection process of active beams, the sensible capacity of the device is but only one of the criteria considered by the design team. Equally important, are elements such as: aesthetics, serviceability, acoustics, characteristic pattern (throw and drop) and comfort (ASHRAE – Std 55). The launch of ASHRAE Std. 200-2015, captured the testing methods by which much of the design criteria could be properly reported by all manufacturers. This test standard effectively combines thermal performance testing metrics, acoustic content, and throw pattern information, which in turn, provides the design consultant with the necessary information, to properly apply each active beam to the space under consideration. Previously, each of these metrics for performance was reported using other testing methods. i.e. Capacity – EN/DIN151116, Sound / Pattern – ASHRAE Std. 70.

SUITABILITY OF USE:

Once the design team has determined that active beams will be used for a particular building, typically the mechanical design consultant would review the psychrometric profile of each space, to determine its suitability for the use of active beams. As spaces with high latent loads are not always suitable candidates for active beams, this exercise helps to lens clarity to the profile of each space under consideration. It is very common to have several spaces which would be poor candidates for active beam use, including but not limited to: board rooms, bathrooms, kitchens, areas of egress, wet labs, etc.... As an example, in locations whereby the primary air cooling contribution, represents a high proportion of the total sensible cooling capacity of a beam, (i.e. above 80%), these spaces may not be a suitable candidates for active beam use. The cooling contribution via the primary air is typically known as the air-side load fraction. When the air-side load fraction is high, beams effectively become "expensive diffusers".

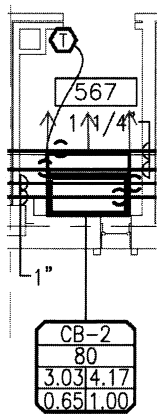
PLACEMENT & COMFORT:

Once each space has been validated for active beam use, the beam selections would be completed, and placed within the reflected ceiling plan, for lighting co-ordination, and pattern study. Effectively, beams act like linear slot diffusers, when considering their discharge characteristics, and throw information. Typically, T150-T100-T50 throw data, is needed to place beams within the reflected ceiling plan. The placement process begins by using the same guidelines that have been traditionally used for the placement of linear slot diffusers.

It is key that the design consultant works closely with the architect, to ensure that lighting fixtures and architectural integration do not negatively influence the mechanisms by which the active beams process air within the space. Beams mounted above the finished floor at high levels (above ~14' [4.3m]), behind architectural slatted ceilings, and other architectural features, must be positioned in a way that allows the beams to properly function, and appropriately distribute the beams' discharge air, to prevent thermal discomfort. It is also essential to never impede the return air pathway to the beam mounted coil, and to ensure adequate clearance is provided, for beams to effectively develop Coanda, circulate the room air, and remain serviceable within each space.

Beams mounted in areas without a conventional ceiling are known as "exposed" beams, and require either sheet metal extensions (Coanda wings), or architectural integration elements at each beam's discharge edge, to properly develop Coanda, and create and effective air pattern within the space. Narrow rooms may require 1-way discharge beams, and/or pattern controllers to limit the beam's throw, preventing colliding air streams, and draft. Active beams sometimes may need to be placed in an offset biased location, to ensure that buildings with poor glazing are properly "washed" by the discharge air, to effectively manage glazing surface temperatures. Orienting the beams either parallel or perpendicular to the façade may need to be driven by the HVAC needs of the space, pending the quality of the glass, rather than for architectural appeal. It is best to prime the discussion in advance with the architectural team, such that these limitations are not a surprise as the layout progresses. Louis Sullivan's maxim "form follows function" is exceedingly salient in the case of active beam layouts.

Figure 2) Sample room beam layout (WU – Music Hall, Room 567)



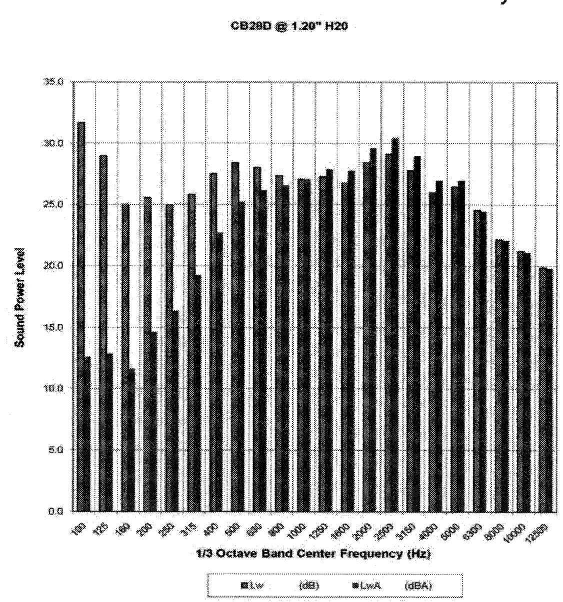
In room 567 left, we see an exposed 1-way discharge beam, equipped with a Coanda wing. As a result of the existing construction, and the limited ceiling height, the beam was mounted as a free-hung (exposed) unit with Coanda wing, to ensure that the room air distribution minimized the risk of draft, and captured convective air currents rising from the limited adjacent glass. Clearly, had the beam been mounted perpendicularly to the exterior wall, the narrow width of the room would have been at a much higher risk of draft. The placement process may drive a re-iterative solution for a given space, as limitations of each room may require alternative beam characteristics, and/or appurtenances to effectively manage the space, and its air flow.

Also, it should not be surprising, that if after deeper analysis, it is determined that an active beam is not suitable for a particular space. It is not uncommon that even after psychrometric validation that beam placement struggles, preclude the use of beams in a particular space. It is not recommended that beams be "forced" into being applied to a given space. Rather, allow optimal design practice and good engineering principles guide both the selection criteria, and functional application of this equipment, in each space which is studied.

ACOUSTICS:

In the case of the music hall, as one could imagine, acoustics became a driving element to the beam selection process. Beams with smaller nozzles, and longer lengths are often times needed to create a situation whereby the acoustic spectrum of a beam can be chosen to match the requirements of the space. This is a direct example whereby capacity was not the only criteria by which beams were selected. The use of potentially longer beams, with smaller nozzles, becomes a conscientious decision in the pursuit of the selection goal, rather than simply the lowest possible capital cost. Similar criteria relative to throw pattern may also be applied, when the limitations of the selection process would otherwise drive the selection to the highest possible sensible capacity device. Some test data (ASHRAE Std. 70) reports a characteristic room attenuation of 10 dB. However, not all rooms will yield a 10 dB room effect. It is recommended that the design team closely review all performance data, to ensure that the characteristic equipment considered, aligns with the expectations of the space.

Figure 3.0) Characteristic 1/3rd octave band active beam content for acoustic analysis.



Clearly, an active beam is not just a sheet metal box, with a coil. Although induction technology is not a new concept, it is evident that to properly apply this equipment in a given space, much more information is needed about how this terminal device will be applied beyond simply meeting the sensible capacity of a room. There is no magic to this technology. Rather, solid information about the performance characteristics of a particular unit, and sound engineering, is all that is required, to integrate this highly effective and efficient technology, into today's high performance buildings.

Regards,

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