TECH TIPS

How to Select the Right Overhead Mixing Diffuser for VAV Applications

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Some of the more common questions HVAC design engineers ask are related to the selection of mixing ceiling diffusers. There are many different types of diffusers and each one is selected for a variety of reasons. The easy answer would be to recommend one of the more commonly specified diffusers such as the SCD. The easy answer, however, is not often the right answer if the reason you are asking for a recommendation is related to the complexity of the ceiling space or the space occupancy type.

Selection requests are often driven by one of the following:

- The ceiling has complex geometries or ceiling obstructions, such as lift rails in a hospital patient room, or the air discharge pattern and throw distance may be the main selection criteria.
- The space has a high architectural profile, as is the case with atriums or churches, or the diffuser might need to have a specific look or be required to blend into the esthetics of the space.
- The space has a critical process such as a fume hood or scanning microscope (lab spaces) that mandates a specific air movement pattern.
- There is a need to control airborne contaminates, as is the case in a compounding pharmacy.
- There is a need to wash a wall or window during the heating season to control either surface condensation risk, thermal draft potential or both.
- In all selections of mixing diffusers, the design engineer must also consider the diffuser sound generation (NC), the static pressure drop, and the throw distance at both the maximum and minimum supply air volumes.

As an example, let's consider the case of overhead heating and cooling with the need to wash the exterior wall in heating mode. The occupied space has a 9 ft ceiling height and the room dimensions are 20 ft x 15 ft with the layout shown in Figure 1. In cooling mode the room needs 450 cfm with a supply air temperature (SAT) of 55 °F and in heating mode it needs 220 cfm with a SAT of 95 °F. The room set-point is 75 °F for both heating and cooling. Design requirements include an NC less than 35 and washing the window in heating mode while not causing draft in cooling mode. As a reminder, since the data for throw in the catalog is based on the supply air temperature and the room temperature being the same (isothermal), it is important to remind designers to take into account the change in throw distances due to the air temperature. Luckily, the All-In-One (AIO) software tool will do this during diffuser selection.

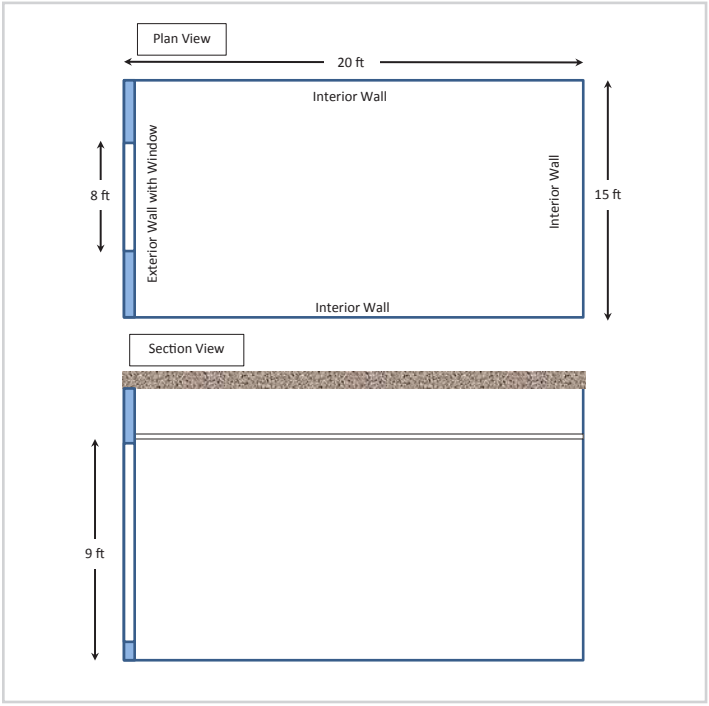

Figure 1: Plan and section view of room

The design requirement is to prevent occupant draft during cooling mode and, while in heating mode, ensure that the air distribution meets the requirements of Table 6-2 in ASHRAE Standard 62.1 in order to maintain the zone air distribution effectiveness of at least 1.0. Table 6-2 in ASHRAE Standard 62.1 requires that for the case of ceiling supply(s) and return, the heating supply air jet at 150 fpm reaches within 4.5 ft of floor level.

I normally recommend the TBD6-HC for this room geometry, as it is designed to throw air along the ceiling in cooling mode and downward in heating mode, and automatically switches the discharge direction based on the discharge air temperature (thermally powered). Since the cooling air is directed along the ceiling plane, the draft risk is greatly reduced. I am placing two 4 ft long TBD6-HCs in the space and have made a selection for both cooling and heating mode. Since there are two diffusers, I based the selections on half of the design airflows for both heating and cooling. I also entered the room dimensions to allow the AIO software to estimate the ADPI (Air Diffusion Performance Index) for the space. ADPI is an index that

is correlated against occupant draft complaint in cooling mode. A proper selection has an ADPI of 80% or greater. An ADPI < 80% may result in cold draft complaints from occupants. I recommend that the ADPI is always calculated as it is a quick check to help lower the potential for occupant draft sensation. It should be noted that the ADPI value is not considered valid for heating mode. Also, the ADPI is only calculated for horizontal discharge.

Figure 2 shows the AIO selection of this diffuser type for cooling mode. Note that the SAT differential is -20 °F (55 °F – 75 °F), the horizontal throw for 50 fpm is 27 ft (shown on the top line of throw distances), the NC is 20, and the ADPI is 82% (> 80%).

Figure 3 shows the AIO selection of this diffuser type for heating mode. Note that the SAT differential is 20 °F (95 °F-75 °F); the vertical downward throw (as shown on the second line of throw distances) for the 150 fpm is 5 ft, which meets the 62.1 Table 6-2 requirement; and the NC is <15, as indicated by the "-".

Figure 4 shows the discharge patterns and relative throw distances for both heating and cooling mode.

This is only one example of a selection for a specific application. A complete review of this topic is included in the Price Engineer's HVAC Handbook, Chapter 9—Mixing Ventilation. You are encouraged to refer to this publication for further information and design guidance.

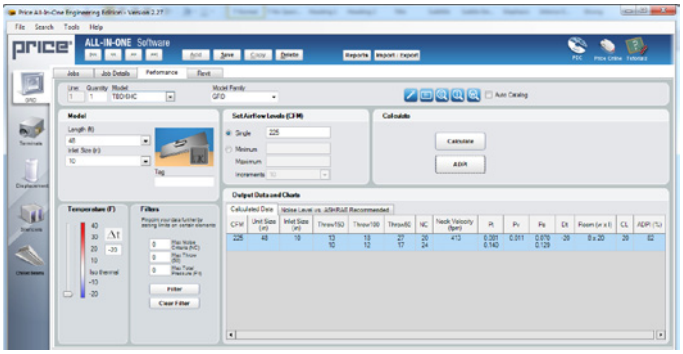

Figure 2: AIO Selection for cooling mode

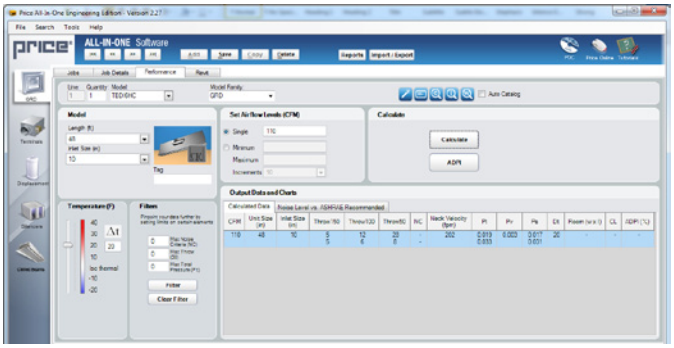

Figure 3: AIO Selection for heating mode

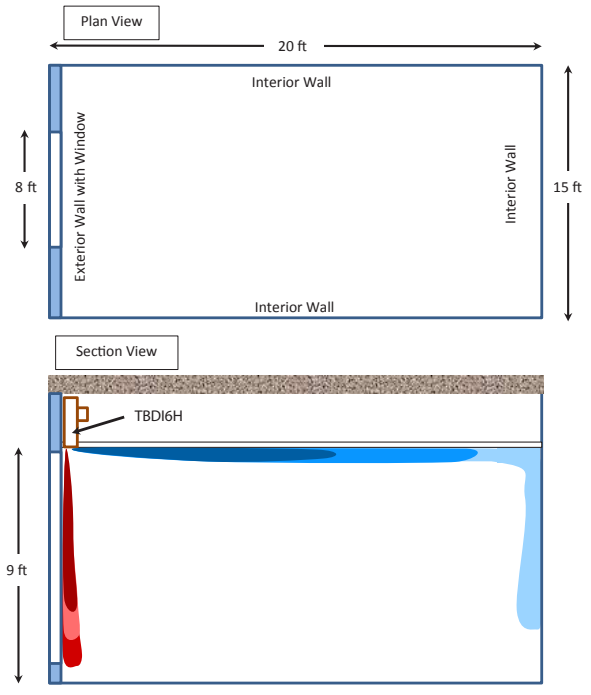

Figure 4: Diffuser placement and air discharge patterns for heating and cooling modes